Chemical Congineering JULY 1954

FRESH APPROACH TO

Lubrication

Page 211

New pvT Charts

Page 203



Higher Capacity Greater Versatility Increased Efficiency

Catalysts



TYPICAL RESULTS

MORE AMMONIA was required by a large producer, but without additional expansion of facilities. Girdler was contacted, began its research and development, formulated two special, highly active catalysts, G-19 and G-3. The result was 75% additional ammonia output . . . at no sacrifice in quality, and requiring not a dollar of extra investment in plant equipment.

"ACETYLENE-FREE" was the product specification of an ethylene manufacturer. Girdler's technicians formulated catalysts that would selectively hydrogenate acetylene with the ethylene present. Result: Ethylene with less than 50 ppm of acetylene—a 99% reduction.

HIGH-PURITY HYDROGEN for edible oil processing had to be free of carbon monoxide, which has a deleterious effect on product quality. G-12, a highly active durable catalyst, was developed to remove the impurity. Carbon monoxide content was cut 95%, resulting in hydrogen with less than 5 ppm of carbon monoxide.

How you benefit from GIRDLER leadership in catalyst technology

HIGH QUALITY Girdler catalysts enjoy industry-wide recognition as the answer to many tough catalyst problems. Girdler manufactures many types of catalysts for a wide range of processing applications. Our experienced catalyst technicians are well-qualified to work with you to prepare catalysts to meet your specifications. Or, if preferred, we will take your formulae and tailor-make catalysts to your exact requirements.

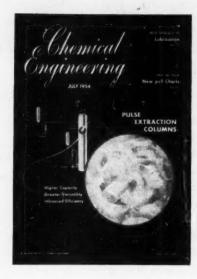
Why not take advantage of Girdler's experience in solving catalyst problems? For further information on standard, commercially-proven Girdler catalysts or on our catalyst engineering service, call the nearest Girdler office today.

The GIRDLER Company

A DIVISION OF NATIONAL CYLINDER GAS COMPANY
LOUISVILLE 1, KENTUCKY

GAS PROCESSES DIVISION: New York, Tulsa, San Francisco.
In Canada: Girdler Corp. of Canada Ltd., Toronto

GUIDED TOUR JOHN R. CALLAHAM, EDITOR



New Look, Better Service

That's what we've done with our Reader Service section. We've revamped it completely.

We've reorganized the entire section to make it easier, faster to use. You'll find, for instance, most of the material now organized into categories, all items alphabetized within categories. RS is now truly a finger-tip reference.

We've also expanded the contents to make each section more complete, hence more useful. You'll now find, for example, our Index to Chemicals and Equipment a complete reference to each month's advertised items and new product developments.

Our streamlining of RS has been inspired by its popularity and by the fast-growing use you're making of it. We're now getting close to 20,000 requests a month for more information and we relay every one of these to the manufacturer within 24 hours. That's speed in volume!

Our "new look" RS begins on page 403 in this issue—JRC

Pulse columns: New key to faster, better liquid-liquid extraction.

No doubt about it, pulse extraction is one of today's hottest developments in unit operation techniques. It can speed up mass transfer as much as 10-fold.

Here's an up-to-date, practical critique of pulse columns—what they are, how they work, what they can do for you. It's an exclusive roundup by two of the pioneer workers in this fast-moving field. (p. 183)



How to Design for low temperatures.

Gas separation processes at low temperatures often hinge on the skillful handling of tricky heat transfer problems. Here Bob Sweeney takes a designer's approach to a little-known field. (p. 197)



Here're your brand-new pvT charts.

Yes, a new set of generalized compressibility charts for 30 common gases that'll come in handy for years. CE's unique pressibility



Please turn page



entation will help speed up your engineering computations. (p. 203)



Take a fresh look at lubrication.

You'll find a lot of practical tips in this 18-page special report from DuPont. Now it's easy to figure out what to do with just about any piece of equipment—big or little, simple or complex. (p. 211)



The whats and hows of metallizing.

Here's the low-down on this important tool in fighting corrosion: What it is, where it's used, how much it costs, why metallizing systems are finding new uses in chemical plants. (p. 189)



Are you a muddle-head?

Of course not. But your management may think you are if you write reports they can't grasp. Yet nine simple rules applied to your technical writing can stamp you as a man who thinks straight. (p. 250)



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FLASHING LIQUIDS?

THE ANSWER IS



Another Famous

Hammel Dahl

First

FLASH-FLO

PLUG

ELIMINATES.

- DESTRUCTIVE VIBRATION
- . TRIM DETERIORATION
- HIGH NOISE LEVEL

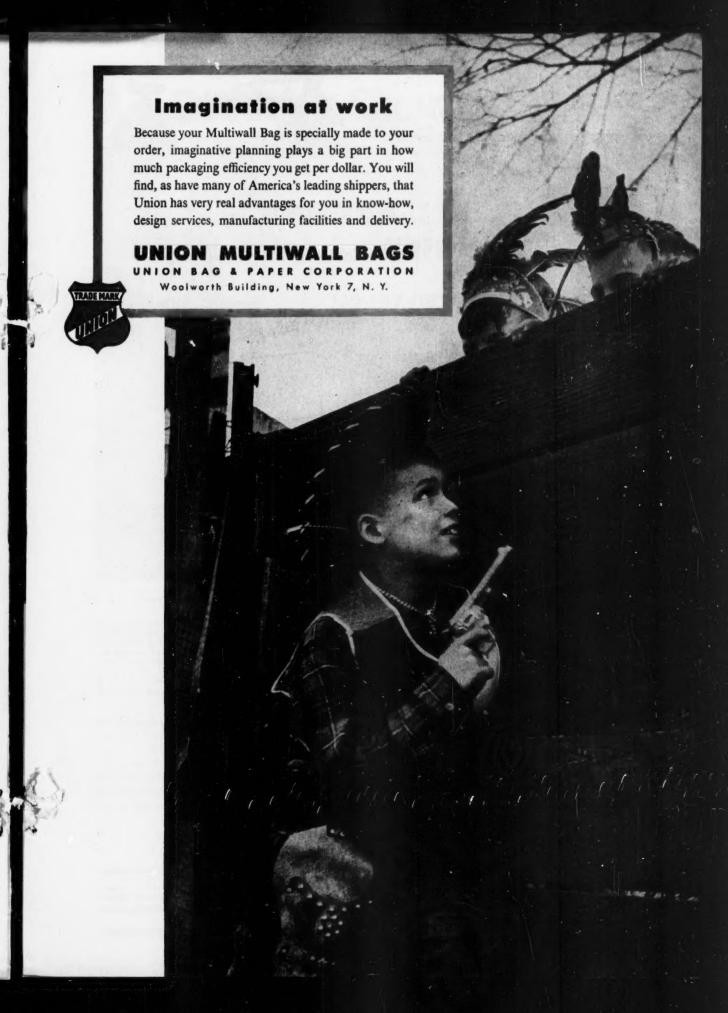
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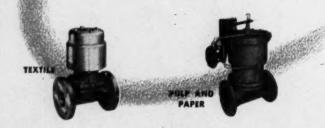
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MANUFACTURING PLANTS IN WARWICK, R. I., U. S. A., CANADA, ENGLAND, FRANCE AND HOLLAND CANADIAN MANUFACTURING AFFILIATE—GUELPH ENGINEERING CO., GUELPH, ONT.





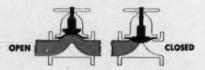
in industrial circles!



GRINNELL-SAUNDERS DIAPHRAGM VALVES

In industrial plants all around, Grinnell-Saunders Diaphragm Valves are preferred. Why? Because they have proved themselves economical and efficient in handling materials as diversified as corrosive fluids, gases, beverages, foods, compressed air, suspended solids . . . in lines where corrosion, abrasion, contamination, clogging, leakage and maintenance are costly factors.

Grinnell-Saunders Diaphragm Valves are available in a range of bodies, linings and diaphragm materials . . . and in a variety of styles and operating mechanisms. If you have a valve problem, it certainly will be well worth your while to consult a Grinnell engineer.



Types of Grinnell-Saunders **Diaphragm Valves**

Bodies

sees Screwed ends — 1/4" thru 3"
Flanged ends — lined or unlined, 1/2" thru 18"
Butt weld ends — 1/2" thru 6"
Socket ends — 1/2" thru 4"

Angle Bodies

Screwed ends — 1/4", 1/4", 1/2", 1/4", 11/4", 2" Flanged ends — 1/4" thru 6".

Handwheel operated bonnet (available with rising stem, travel stops, extended stem, chainwheel, adapted for Tejax indicator) Quick turn — lever operated bannet, 1/2" thru 3" Bendix-Westinghouse topworks standard (air to close — spring to open) Robatair, '44" thru 1" Rotechamber, 1" thru 4"; in tandem, 5", 6".

direct acting (spring to close — air to open) Robotair, ¼" thru 1" Rotochamber, 1" thru 4" Rotochamber, 1" Intru 4"
Rotochamber, 1" thru 4"
Piston operated, 6" thru 12"
Sliding stem bonnet, 1/2" thru 12"

Diaphragms

Natural rubber, neoprene, reinforced neoprene for vacuum, hycar, butyl, white gum rubber, Kel-F, Teflon, polyethylene.

Body Materials

Iron, bronze, stainless steel, cast steel, aluminum, monel, saran, durimet

Body Linings

Glass, lead, soft rubber, hard rubber, neoprene, saran

Bronze Beer Valves

NIE BEST VILLES
Socket both ends
Socket end to flange end
Flange both ends
Socket end to male hose thread end
Flange end to male hose thread end
Male hose thread both ends



CHEMIC

Grinnell Company, Inc., Providence, Rhode Island

Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings . welding fittings . engineered pipe hangers and supports . Thermolier unit heaters Grinnell-Saunders diaphragm valves * pipe * prefabricated piping * plumbing and heating specialties * water works supplies industrial supplies * Grinnell automatic sprinkler fire protection systems * Amco air conditioning systems Another new development using

B. F. Goodrich Chemical raw materials



Filter unit contains filters, fittings and inside rings made from rigid Geon. Operator pictured holding an inside ring.

B. F. Goodrich Chemical Company does not make this filter. We supply only the High-Impact Geon resin.

RIGID PLASTIC FILTER COSTS NO MORE..GIVES 6 TIMES MORE WEAR

NDUSTRIAL acid filters made of Geon rigid vinyl plastic are setting new records in cutting costs of nickel plating bath operations. Where stainless steel filters lasted only 3 weeks to 3 months in corrosive nickel plating solutions, these vinyl plastic filters have been on the job for nearly 18 months-with no signs of wear! The cost of the vinyl filter runs about the same as a stainless steel one, but the 6-times longer wear means huge replacement cost savings.

The exceptional resistance of Geon

rigid vinyl to the highly corrosive nickel plating solution, maintained at a temperature of 120°F., points up only one advantage of this basic material. For instance, products made from Geon rigid vinyl can be machined, welded, sawed or drilled. They also resist abrasion, many acids and chemicals.

Geon polyvinyl materials have a wide range of uses in the chemical industry-from rigid filters, tubing, and sheeting to tank and drum linings. We'll help you select the Geon material best suited to your needs. For information, please write Dpt. GE-7, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.



GEON RESINS • GOOD-RIZE PLASTICIZERS . . . the ideal team to make products easier, better and more saleable GEON polyvinyl materials . HYCAR American rubber . GOOD-RITE chemicals and plasticizers . HARMON colors

HOW HERCULES HELPS...

Hercules' business today helps almost everyone's business. It embraces the production
of synthetic resins, cellulose products, chemical cotton, terpene chemicals, rosin and
rosin derivatives, chlorinated products, and
many other chemical processing materials
—as well as explosives. Through close
cooperative research with its customers,
Hercules has helped improve the processing
or performance of many products. We welcome the opportunity to work with you.



Hercules® steam-distilled wood turpentine adds to the value of your paint job—helps paint go on smoother, adhere better, cover more surface. Professional painters and householders prefer this pure spirits of turpentine because it's the best paint insurance their money can buy. Accept no substitutes!



For better appearance and longer shelf-life, product packaging uses inks and overprint lacquers made with Pentalyn® resin. And in making paper and paperboard, manufacturers get top-quality performance and maximum production economies with Paracol® wax emulsion, Pexol® fortified size, and Kymene® wet-strength resin.



Wherever industrial paints have to take a beating—from salt water, acids, alkalies, abrasion, sun—those made with Parlon® (chlorinated rubber) stay on, give better service at lower long-term costs. Parlon paints dry almost as fast as lacquer, and adhere to almost any surface.

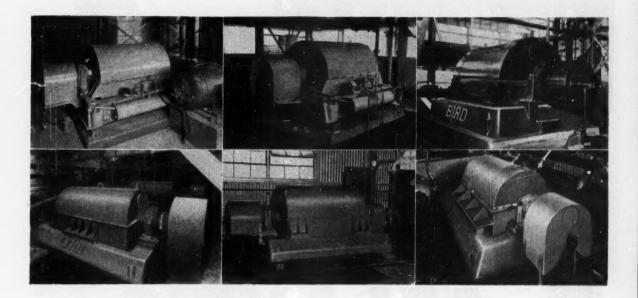


HERCULES POWDER COMPANY

952 Market St., Wilmington 99, Del. Sales Offices in Principal Cities



OF A FEATHER when it comes to UNIFORMLY THOROUGH and EFFICIENT DEWATERING...



All these Bird Continuous Centrifugal Filters are doing the same job — dewatering lime mud before re-burning so that it can be re-used in the lime-soda caustic process.

In this as in so many filtering applications, the uniformly thorough separation effected by the Bird saves a whole lot of money as compared with the old style filters formerly used. Uniform kiln feed greatly increases thermal drying efficiency and decreases the cost of kiln operation and maintenance. Maximum water removal results in fuel savings that run as much as 20 to 25 gallons of fuel oil per ton of lime. Maintenance cost runs less than a cent per ton of carbonate.

Lime mud is but one of a hundred filtration applications where Bird Filters are demonstrating their ability to deliver a better, drier product and more of it per day at lower cost per ton. How about your filtering operations? If the facts and figures aren't already available, the Bird Research and Development Center is set up to provide them.

BIRD MACHINE COMPANY
South Walpole • Massachusetts



Conveying nitric acid for use in batch nitrations is quick death for ordinary flexible metal hase. Sulphuric acid and plating solutions are other notorious killers. When temperature and pressure extremes and adverse handling conditions are also involved, have replacement is frequent and expensive.

That's why—for tough jobs—it's good economy to specify Atlantic flexible metal process hase. Manufactured to survive the most destructive use, it is unequalled for leak-proof qualities, flexibility, durability, strength and lightness. It performs long rifter ordinary hase is scrapped and returns real savings in your material and lobor dollar.

Whatever your application — conveying, controlling movement and vibration, correcting misalignments, compensating for expansion and contraction — there is an Atlantic flexible metal hase that is best for it.

Available in Seamless or Interlocking construction: Steel, stainless steel, monel, branze. W"-36" 1.D. Inclusive with appropriate fittings.

Our engineers have developed flexible metal hose for a number of classified nuclear applications. Though these types cannot be released at present, the experience gained is available for any unusual problems you may have.

Write for Chemical and Process Industries Bulletin 20D.

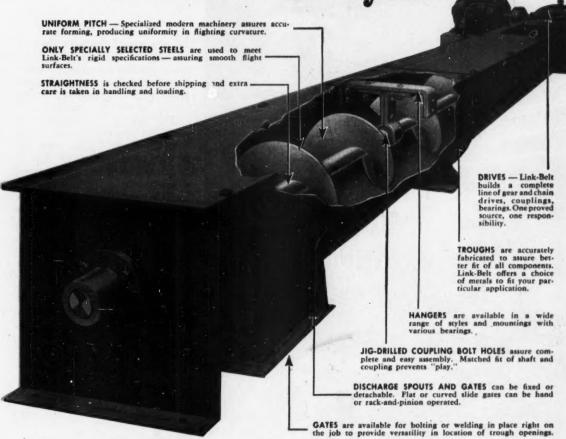
See our Catalogs in Sweet's Files for Product Designers and Mechanical Industries.

ATLANTIC

ATLANTIC METAL HOSE CO., INC. 329 Dyckman St., New York 34, N. Y.

July 1954—CHEMICAL ENGINEERING

There are important differences in screw conveyors



LINK-BELT gives you sound engineering plus accuracy of manufacture for top performance

HEN you buy a Link-Belt Screw Conveyor, you can be sure of efficient operation plus long-life, low-maintenance service. Link-Belt builds all types and sizes of components—you get the screw conveyor that's right for your job . . . with all components completely integrated. What's more, long-lasting efficiency is assured, thanks to Link-Belt's unequalled accuracy of manufacture. Let your nearby Link-Belt sales representative or distributor point out the many important differences in screw conveyors. And be sure he gives you a copy of new Book 2289.

Get this complete screw conveyor book—92 pages of pre-engineered selection and application data. Ask for Book 2289.



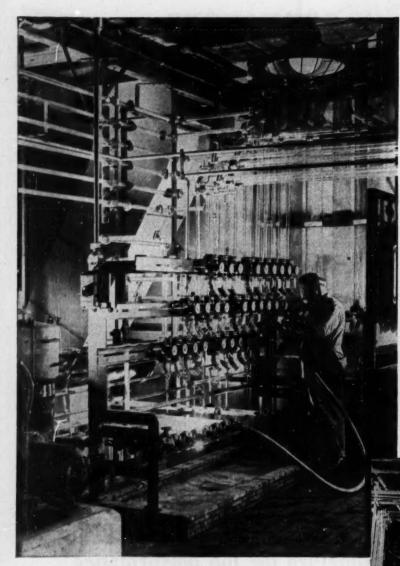
LINK BELT

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LINK-BELT COMPANY: Plants: Chicago, Indianapolis, Philadelphia, Colmar, Pa., Atlanta, Houston, Minneapolis, San Francisco, Los Angeles, Seattle; Scarboro, Toronto and Elmira, Ont. (Canada); Springs (South Africa); Sydney (Australia). Sales Offices, Factory Branch Stores and Distributors in Principal Cities.

This PYREX® pipe

an unusual



IF you toured the pilot plant of Merck & Co., Inc. in Rahway, N. J., you'd see this glass pipe "Switchboard" in action . . . speeding the progress of new products from research toward early production.

The system is constructed of one- and two-inch Pyrex brand "Double-Tough" glass pipe arranged in circuits much like a telephone switchboard. Operators direct flow from various origins to a number of widely separated destinations just by adjusting valves located in pipe manifold stations similar to the two illustrated here.

This system provides the flexibility needed in handling the transfer of a constantly changing variety of chemicals from one processing stage to another. And Merck has constructed its Pyrex pipe switchboard system so that it is instantly adaptable to handling materials with greatly different production cycles.

Operator at one of Merck's PYREX pipe "Switchboards" can crossconnect any of the glass pipelines in the manifold bank easily and quickly. The pipes are easy to clean and can be quickly switched to handling any number of different chemicals.

The handling of materials through this maze of Pyrex pipe is easily controlled by several "Switchboard" or manifold stations. Transparency of the Pyrex pipe lets operators check flow at any point in the line, spot difficulties before trouble has a chance.

CORNING GLASS WORKS, Corning, New York

"Switchboard" does materials handling job

But why PYREX pipe?

Merck chose Pyrex pipe for this complicated installation because only glass offers them all four of these necessary advantages:

- Non-Contamination PYREX pipe is chemically stable. It won't react with or contaminate the contents of the pipeline. It protects product purity.
- 2. Corrosion Resistance PYREX pipe remains corrosion free even under the severest chemical service. It is unaffected by *all* acids except hydrofluoric.
- 3. Clear Transparency Affords complete inspection at any and all points at all times. Trouble can't hide behind glass.
- 4. Light Weight PYREX pipelines require a minimum of support.

Easy to clean . . . in place

A detergent run through PYREX

pipelines followed by water or low pressure steam flushing, or both, generally removes all traces of past contents.

And Pyrex brand "Double-Tough" glass pipe is durable. Experienced users report no breakage problems... even with operating temperatures as high as 250° F. In addition, Pyrex pipe can be installed by regular plumbers or pipefitters.

Let us show how PYREX pipe can help you

Perhaps this Merck installation suggests some Pyrex pipe application for your plant where greater corrosion resistance, improved product purity, or visual inspection can reduce your operating costs or give you closer quality control. Why not discuss your problems with the nearest Pyrex pipe representative—or mail the coupon below for personal attention or further information.

Call on the experience of the nearest Pyrex pipe representative listed here. They will be glad to help you with your problems of handling corrosive or sensitive materials.

BELMONT, CALIFORNIA
Glass Engineering Laboratories

PRESNO 17, CALIFORNIA Valley Foundry & Machine Works

NEW HAVEN, CONNECTICUT

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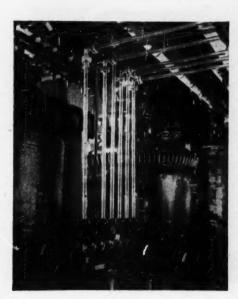
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TORONTO, ONTARIO, CANADA Fisher Scientific Company, Ltd.

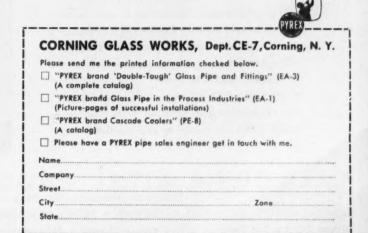
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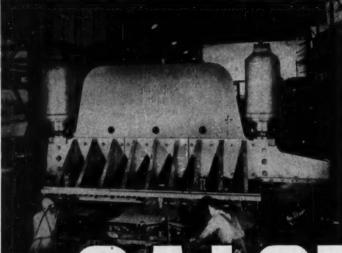


Conning means research in Glass

Another manifold station between two extractors. Liquids from either extractor flow through Pyrex pipe to a pump on the floor then through any one of the Pyrex pipes connecting with other installations.



CUSTOM ENGINEERED FABRICATION

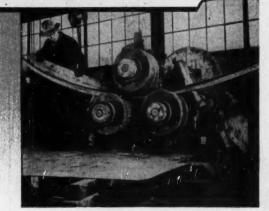


STEEL and ALLOY PLATE
STRUCTURAL · PIPE

for
Process, Oil, Gas
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ENGINEERED FABRICATION

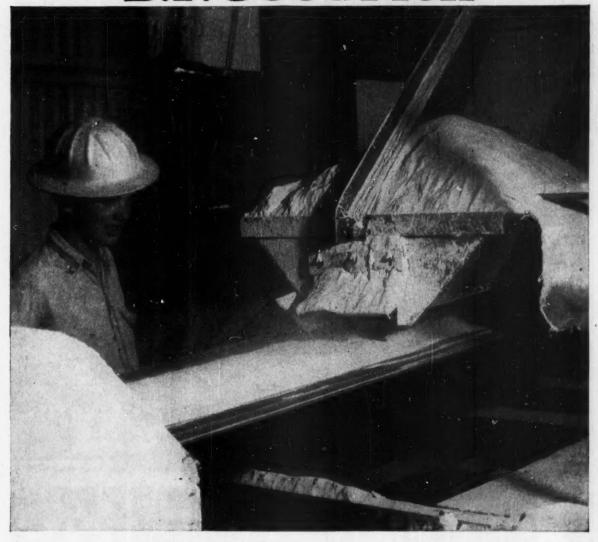
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That white stuff winds up as windows

A typical example of B. F. Goodrich improvement in rubber

THAT steaming white cargo riding the conveyor belt is a special kind of salt, used in making window glass for the nation's stores, factories and homes.

As the salt travels from ovens to storage tanks, it is often 400 degrees hot. And with 1000 sizzling tons to move every day, expensive asbestos belts were burning out in seven months.

Then the company heard that B. F. Goodrich had developed a special heat-resisting rubber for belts that carry such hot materials as coke and

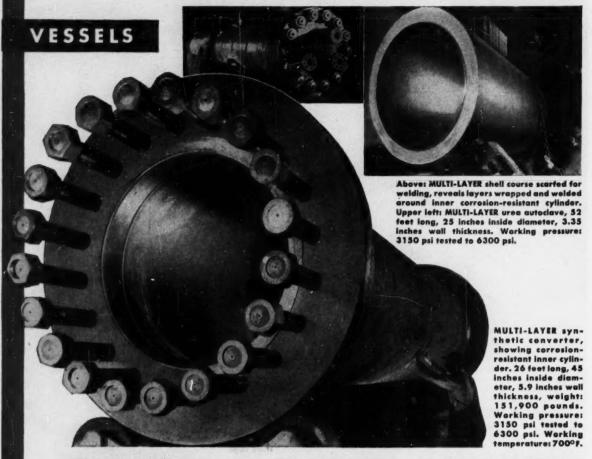
lime. Inside the belt, B. F. Goodrich uses a rayon fabric that not only stands up under heat, but also makes a thinner, more flexible belt.

Put to work here at just half the cost of the asbestos belt it replaced, the B. F. Goodrich belt had lasted 50% longer when this picture was taken. Yet it still went on working until it reached the record of twice as much service.

Making a belt to stand terrific heat is typical of improvements made in other B. F. Goodrich belts—belts to carry materials that tear and cut ordinary rubber, stand crashing blows of dropping coal and rock, carry oily foods and grains, move packages uphill and down. B. F. Goodrich research constantly improves them all. That's why it will pay you to find out what recent improvements B. F. Goodrich has made in any rubber product you use. Call your local BFG distributor, or write The B. F. Goodrich Company, Dept. M-259, Akron 18, Ohio.

B.F. Goodrich

A.O.Smith for



MULTI-LAYER MEETS

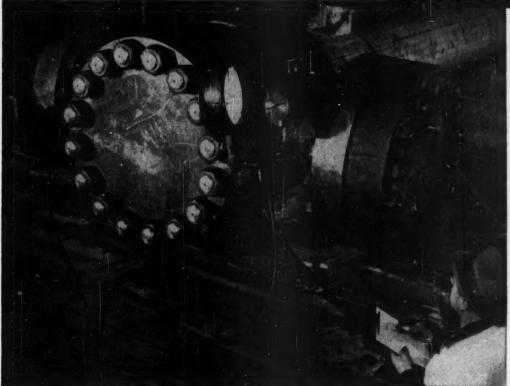
The designer's answer to higher pressures, temperatures, and more critical corrosion problems...with safety

As processing problems become more acute, A. O. Smith MULTI-LAYER construction of vessels and heat exchanger shells becomes more and more important to equipment designers and buyers.

Future requirements of processors are being solved with this time-tested design. MULTI-LAYER inherently satisfies all of the conditions of modern operation: extreme pressures, elevated temperatures, critical corrosion. Because MULTI-LAYIR construction consists of wrapping and welding successive concentric layers of relatively thin steel plate around a central, pressure-tight cylinder, no size or weight limitations are imposed, making it possible to design the vessel to fit the requirements of the process. Since the inner cylinder is pressure-tight, load-bearing layers are provided with vent holes to prevent damage from over pressure and to serve as automatic safety and warning devices in the remote event of runaway overload. In applications, involving hydrogenation, venting prevents embrittling attack on the load-bearing layers. For corrosive service, the inner cylinder

Outstanding Advantages

EXCHANGERS



Inter cooler (heat exchanger) with U-tube construction, being tested before shipment. Operating pressure: 2500 psi.

CHALLENGE of FUTURE

is fabricated of lined or clad plate, alloy steel or nonferrous material to meet the processing condition.

Bigger batches to effect economies and meet competition in an expanding market can be planned. Advanced processing methods can be implemented. Our own designers, engineers, and research staff will welcome opportunities to assist in adapting MULTI-LAYER vessels and heat exchangers to your needs.

Send for MULTI-LAYER Bulletins: V-52, MULTI-LAYER Manufacturing and Assembling, and V-53, MULTI-LAYER Engineering for Safety.



A.O.Smith

Vessels and Heat Exchangers

Licensee in Canada: John Inglis Co., Ltd., Toronto

For glass-lined process equipment, contact GLASCOTE PRODUCTS, INC., Cleveland 17, Ohio—A new A. O. Smith Subsidiary



Everybody's in the act * on this one!

CHEMICAL ENGINEERING's editorial and layout teams are going full blast...the Research Department is pitching in... every McGraw-Hill district office in the country is hot on the trail of new trends, new developments, fresh happenings and really important contributions to CP1 progress over the past 12 month period.

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You've got a reference library in the making because we'll bring them to you once a year from now on...

to give you a continuing source of significant developments that affect the chemical engineer, his job and his future.

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Everything is being pointed up to provide greater ease of scanability and usability.

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we called on you for personal interviews to determine the kind of reference issue you wanted. We've incorporated as many of your ideas as possible in this "Annual Inventory Issue."

Watch for it ... it's coming in September!

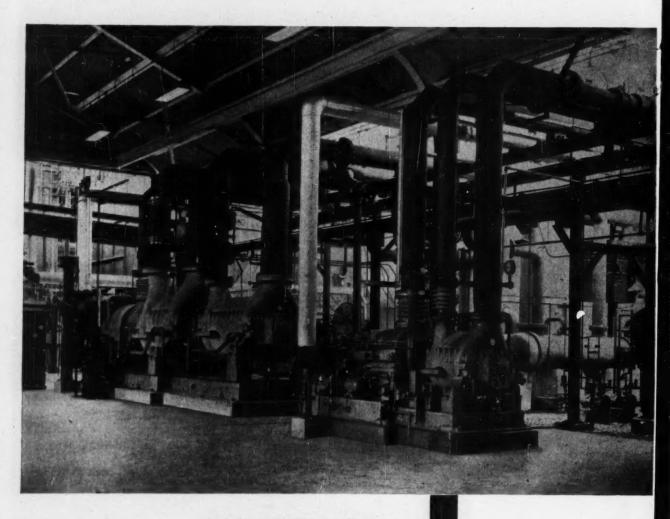
more engineering-minded men read it ...

more chemical engineers profit from it . .

Chemical
Engineering

A McGRAW-HILL PUBLICATION 330 WEST 42nd ST., NEW YORK 36, N.Y.

Three newest partial oxidation plants in the U.S. use centrifugal air compressors



On the left a 5000 BHP steam turbine drives a five-stage No. 4 Compressor and an eight-stage No. 3 Clark Multi-Stage Centrifugal Compressor. Rated at 20,000 CFM, alr is pumped to 125 PSIG. The ether unit is a Clark four-stage No. 2 Centrifugal Compressor rated at 650 BHP compressing nitrogen.

all 3 select Clark Centrifugals

When Spencer Chemical Company's new Vicksburg, Miss, ammonia plant recently went on stream, it became the first of three new plants which will use centrifugal air compressors in the partial oxidation method of making hydrogen. Significantly, all of the plants have selected Clark Multi-Stage Centrifugal Compressors.

The new Spencer Chemical plant, which manufactures ammonia, nitric acid, ammonium nitrate and ammoniating solutions, is outstanding for its compactness and high degree of process integra-

The continued preference for Clark Centrifugals to serve varied process applications is the natural result of many points of superiority which your nearest Clark representative will be glad to detail for you.

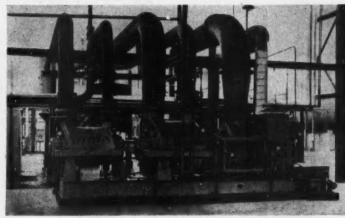
CLARK BROS. CO. . OLEAN, N. Y.

DIVISION OF DRESSER OPERATIONS, INC.

Sales Offices in Principal Cities Throughout the World



compressors



A 3800 BHP turbine driving a five-stage No. 3 and an eight-stage No. 2 Clark Centrifugal Compressor. Capacity of this unit is 15,000 CFM with a discharge pressure of 125 PSIG.

5 outstanding Clark Centrifugal features

STANDARDIZATION

Simplifies installation, operation and maintenance. Units readily adaptable to existing pipe arrangements and future plant expansion.

Clark leads the field in the number of available types and the development of new seals for specialized

RUGGEDNESS (Unitized design, Bearing chambers cast integral with case. Accurate alignment maintained at high speeds and pressures.

Clark experience in handling so many different and difficult applications saves you money and speeds your delivery by eliminating the need for performance testing. Only a mechanical test is required. Clark knows the performance of its machines.

COOLING

Enables accurate control of process temperatures. Cooling and compression duties separated. Reduction in horsepower. One unit often can do the work of two.

Clark sets the pace in compressor progress

A Shadow of

Things Yet to Come

A great deal has happened since the inception of this company four years ago. It has been a time of exceptional growth, progress, achievement.

The broad range of work undertaken includes the simple and the complex . . . complete refineries and auxiliary units . . . crude units and office buildings . . . turnaround operations and laboratories. And the field of operation has expanded to become international in scope, with "Built by Procon" a well-known term even in the more remote parts of the world.

We are proud of the men in our organization whose talents, experience and unbounded energy have made these achievements possible.

But we are even more conscious of, and grateful for, the confidence placed in us which, from the very start, has been so clearly evidenced by all those whom we have served.

The accomplishments of these past four years . . . great as they seem to this young business . . . will, we are confident, prove to be but a shadow of things yet to come.

PROCON Incorporated

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How Servel Water Chillers

Solve your Cooling Problem

O

Regardless of cooling needs

The adaptable Servel 25-ton Water Chiller uses water as the refrigerant—provides economical cooling for air conditioning, process

conditioning, process cooling, or industrial pre-cooling. Your Servel dealer can show you performance figures on applications most similar to your needs, in any of the three fields. 0

With the most economical fuel

Steam from the most economical source—gas, oil, LP gas, even waste heat—op-

erates the unit, by Servel's exclusive, nomoving-parts absorption principle of refrigeration. This wide choice assures you of low operating costs... as does Servel's high operating efficiency.

3

Under every installation situation

Light floor loading and vibrationless operation means that no special foundations or floor braces are needed—in penthouse, on individual floors, or in basement. Simple piping, instead of expensive duct work, cuts installation time and costs. Zone control is unusually easy.



With exclusive assurance of satisfaction

The Servel Water Chiller cooling system has no moving parts to wear, thus it is quiet and vibration-free. Every Servel Water Chiller is backed by a 5-year warranty. See your Servel dealer or mail coupon for information and engineering co-operation.

MAIL NOW FOR COMPLETE DETAILS!

Servel

the name to watch for great advances in

AIR CONDITIONING VREFRIGERATION

SERVEL, INC., Dept. CE-74, Evansville 20, Indiana

Please send me complete information on Servel equipment for

Air Conditioning,

Process Cooling,

Industrial Precooling.

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CHEMICAL PUMPS

MADE OF REAL



to the problem of pumping Corrosive Solutions

The corrosion resistance of Ingersoll-Rand chemical pumps covers the entire range from strong sulphuric acid to strong caustic soda. Their ability to handle these corrosive solutions is the result of years of laboratory research in the development of suitable metals and alloys-and still more years of field testing to prove the soundness of construction and design.

All parts of the pump that come in contact with the liquid are made of IRCAMET-a high nickelchromium-molybdenum alloy steel that has been specially formulated to provide maximum resistance to the widest possible range of acids and alkalis.

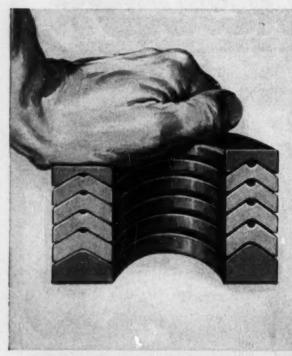
The problem of leakage, too, has been successfully solved by a patented LEAKOLLECTOR stuffing box gland. Completely encircling the shaft and stuffing box, this split-type gland permits any leakage to be drained away for collection or disposal. In addition, all I-R chemical pumps can be supplied with a CAMERON SHAFT SEAL in place of the conventional stuffing box. This self-lubrication mechanical seal requires practically no attention or maintenance.

These performance-proved I-R chemical pumps are available in capacities from 10 to 4000 gpm, in sizes from 1/4 to 125 hp. For complete information, write for Bulletin No. 7095. Or, if you have a special pumping problem, contact your nearest Ingersoll-Rand representative. He will be glad to help you.

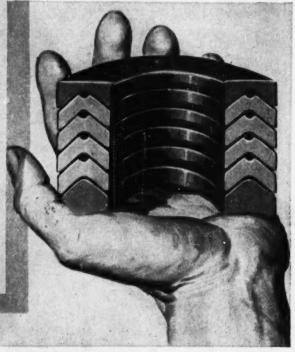
11 Broadway, New York 4, N. Y.

CONDENSERS TURBO-BLOWERS COMPRESSORS AIR & ELECTRIC TOOLS ROCK DRILLS PUMPS

See for yourself how U.S. Matchless Packing reduces wear on rods, reduces packing costs



This demonstration set of U.S. Matchless has been cut in half. When set is squeezed by hand, note how the lips spread out. Then note what happens when the pressure is released...



When pressure is released, the lips retract. This action duplicates what happens when U.S. Matchless is subjected to hydraulic pressure *plus* subsequent release, as on a reciprocating rod or hydraulic ram.

The photos above show how pressure (whether gas or fluid) forces the double pliant lips of U.S. Matchless® Packing against the rod and side of the stuffing box. This self-adjusting, automatic action plus the blunt edge design reduces wear on the rods, prolongs packing life and hence lowers maintenance costs.

U. S. Matchless is recommended as original equipment by some of the largest makers of hydraulic presses and makers of rotary oil drilling rigs. It is ideal for rams, accumulators, triplex pumps and oil well swivels. It is designed to handle hot and cold water, brine and ammonia, hot and cold oils, crudes, gasoline and all petroleum products, and is a favorite of manufacturers of liquid or gaseous materials.

U.S. Matchless Packings are obtainable through any of our selected distributors or any of our twenty-seven District Sales Offices, or by writing the address below.



"U.S." Research perfects it.
"U.S." Production builds it.
U.S. Industry depends on it.

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Announcing . . . new 88-page SILENT CHAIN DATA BOOK

Here's a complete, easy-to-use guide to efficient drive selection

THIS comprehensive book covers all phases of industrial silent chain drive application. Complete information is included on drive selection . . . chain and wheel specifications . . . casings, lubrication, installation and maintenance. Illustrated are the wide range of drive applications on which Link-Belt Silverstreak Silent Chain can save you money.





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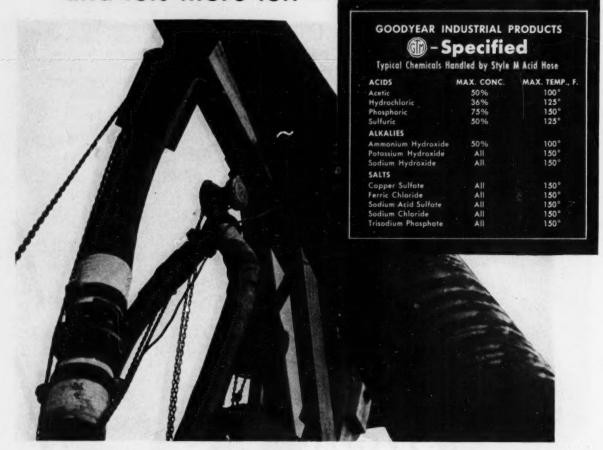
LINK-BELT COMPANY

220 S. Belmont Ave., Indianapolis 6, Ind. (or your nearest Link-Belt office)

Please send a copy of your new Silent Chain Data

DOUBLE THE LIFE

and lots more left



The service is loading tankers with concentrated, liquid caustic soda. The pumping is continuous. The volume is 1,000,000 gallons every 17 days. And the average life of previously used hose was nine months to a year.

The G.T.M. - Goodyear Technical Man - specified Style M Acid

Suction and Discharge Hose for this unusually rugged service. At last report, it had served more than two years, carried well over 40,000,000 gallons and was still in good condition—good for many gallons more.

Whatever your hose needs, the G.T.M. can give you the right one for longer life at lower cost. Contact him through your Goodyear

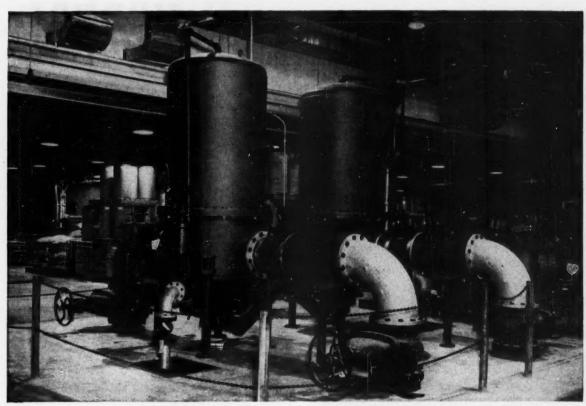
Distributor or by writing Goodyear, Industrial Products Division, Akron 16, Ohio.

YOUR GOODYEAR DISTRIBUTOR can quickly supply you with Hose, Flat Belts, V-Belts, Packing or Rolls. Look for him in the yellow pages of your Telephone Directory under "Rubber Products" or "Rubber Goods."

GOODFYEAR

THE GREATEST NAME IN RUBBER

We think you'll like THE GOODYEAR TELEVISION PLAYHOUSE-every other Sunday-NBC TV Network



EVERY GRAIN OF SAND IS REMOVED from the well water passing through these abrasion-resistant FLO-KLEAN filters at the new Upjohn Company plant in Kalamazoo, Michigan.

Upjohn saves 2000 dollars a month

FLO-KLEAN filters protect valuable equipment at pharmaceutical plant

Maintenance records at the Upjohn Company's ultra-modern plant near Kalamazoo, Michigan, show that FLO-KLEAN filters are responsible for saving up to \$2000 a month in maintenance costs.

These Cuno FLO-KLEAN filters, used to remove sand and gravel from incoming well water, ordinarily take something like a teaspoon of sand out of each thousand gallons. That doesn't appear to be an impressive quantity, but it could cause serious damage to stainless steel valves, pumps, water softeners, condensers and other valuable equipment. Purity of process water is assured by the high-capacity FLO-KLEAN units.

Recently the wall of one of their thirteen 250 feet deep wells gave way, dumping large quantities of sand and gravel into the water system. Every bit of this sudden deposit (almost seven cubic yards) was removed by the FLO-KLEAN filters. Without interrupting service, FLO-KLEAN continued its automatic operation and saved Upjohn a serious operating and maintenance loss.

In hundreds of applications throughout industry the fully automatic, continuously self-cleaning FLO-KLEAN filters have paid for themselves many times over by making river, lake, or well water fit for industrial use . . . and without loss of backwash water. Other uses include reclaiming industrial process water and coolants. If you need or use between 200 and 100,000 gallons per minute of clean water, find out how FLO-KLEAN can save you money. Write for free FLO-KLEAN bulletin to the Cuno Engineering Corporation, Dept. 101F Meriden, Conn.



Removes More Sizes of Solids From More Kinds of Fluids

AUTO-KLEAN (disc-type)

MICRO-KLEAN (fibre certridge)

FLO-KLEAN (wire-wound)

results of

Alco EXPERIENCE

... gained through many years of designing and building heavy-metal equipment for refining and processing companies the world over.

and

Alco FACILITIES

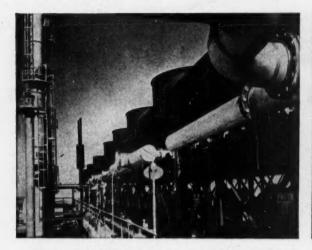
... capable of handling economically an extremely wide range of metal-fabricating operations... of meeting strictest customer specifications.



150 FT "TRAIN" HEAT EXCHANGERS, designed and built by Alco with special flange-to-flange construction, step up efficiency at Tennessee Gas Transmission Company's huge gas processing plant at Gabe, Kentucky. Other Alco units at Gabe include ethylene flash drum, demethanizer tower, primary feed cooler.

PROCESSING problems

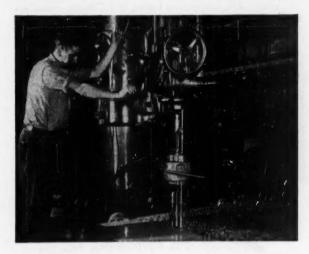
... examples of the wide variety of heavy-metal equipment designed and built by Alco to meet today's demands in petroleum and petrochemical processing.



SPECIAL ALCO AIRCOOLERS, with many components of aluminum and stainless steel, handle 80 percent of cooling load at Celanese Corporation's new 630-acre petrochemical plant at Pampa, Texas. Units have removable headers and slide-out tube bundles, operate in constant presence of highly corrosive acids, chemicals and gases.



PRIMARY AND ATMOSPHERIC TOWER CONDENSERS, plus stabilizer condenser, naphtha cooler, kerosene and diesel oil exchangers, are among the many Alco units at Canadian Oil Refineries' new \$23,000,000 plant at Sarnia, Ontario. This plant produces more than 115,000,000 gal. of gasoline annually, claims first catalytic reformer in Canada.



EIGHT FOOT RADIAL DRILL at Alco's modern, completely equipped plant at Dunkirk, N.Y., has multiple head for the precision drilling or reaming of several holes simultaneously. Unique facilities like this, many of them Alco designed, enable Alco to fabricate dependable, profit-building answers to toughest processing problems.

Let Alco facilities and experience produce profit-building answers to your processing problems. Contact your nearest Alco Products sales representative today. Offices in Dunkirk, New York, Chicago, Los Angeles, Kansas City, Houston, Tulsa and Beaumont.

ALCO

AMERICAN LOCOMOTIVE COMPANY

Sales and Service Offices in Principal Cities

WHEN THE TIME
CLOCK WAS INVENTED

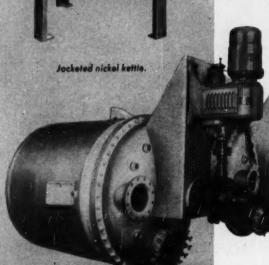


POVEN

WAS MAKING INDIVIDUALIZED CHEMICAL EQUIPMENT

The speed and efficiency with which the newly-invented time clock maintained employee records quickly established it as an indispensable aid to American industry. Chemical manufacturers of this period were also quick to make use of the greater speed and efficiency possible with KOVEN Individualized Equipment, specifically designed to their exact needs. Today, as then, KOVEN's expert craftsmanship and know-how are at the service of the chemical industry—enabling manufacturers to achieve higher and faster production with cost-cutting, dependable KOVEN units. If you have a production problem, one of our trained representatives will be glad to discuss it with you—of course, there is no obligation. Send for Facilities Catalog #490.

Complete modern facilities including X-ray inspection and stress relieving which insure quality control. KOVEN equipment in all commercial metals and alloys include: pressure vessels, extractors, mixers, stills, condensers, kettles, tanks, chutes, containers, stacks, breechings, coils. Fabrication to A.S.M.E. Code Par. U-68 and U-69 a specialty.





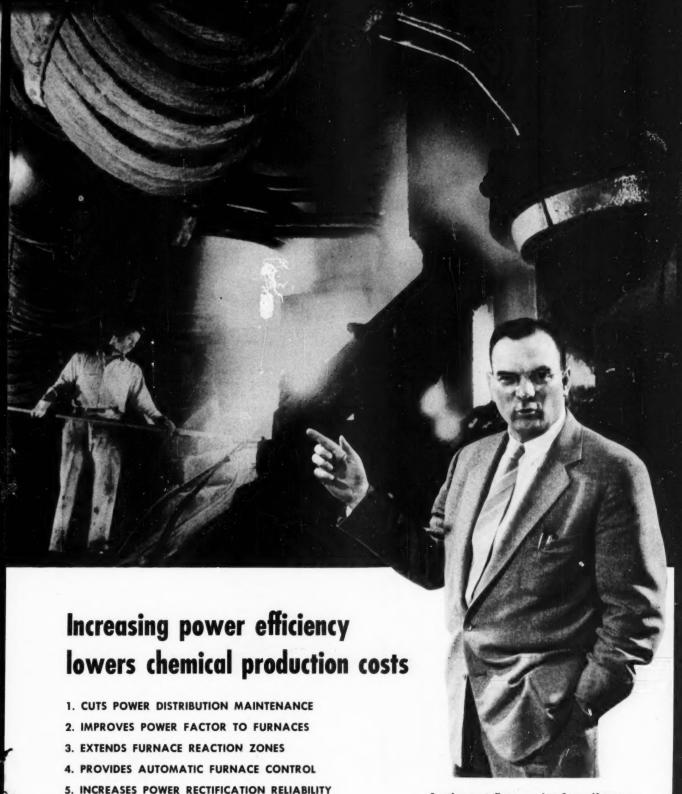




L. O. KOVEN & BRO., INC. 154-B Ogden Ave., Jersey City 7, N. J.

A.S.M.E. Code jacketed tank with bolted cover and drive.

KOVEN FOR INDIVIDUALIZED EQUIPMENT SINCE 1881



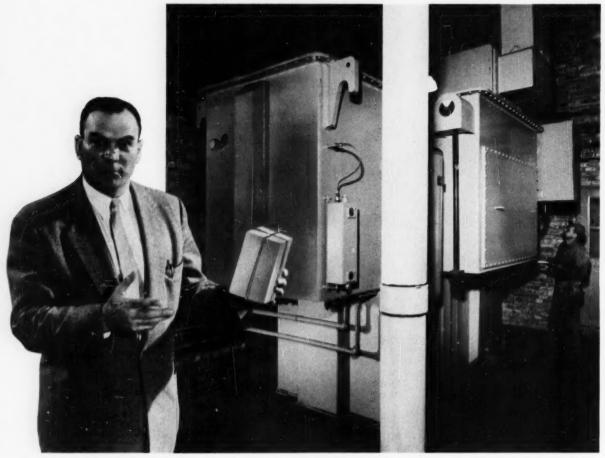
On the next 7 pages, Ira Coen, Manager, Chemical Industry Sales, Westinghouse Electric Corp., shows you how the right combination of electrical equipment cuts pro-

YOU CAN BE SURE ... IF IT'S Westinghouse

6. REDUCES HAZARDS OF CORROSION

7. REDUCES TOTAL POWER CONSUMPTION

Packaged installation resulted in improved power efficiency gain at this plant



Shell-type Westinghouse Furnace Transformer serving phosphorus reduction furnace. Provided high power factor, cut total power costs.

Shell transformer can be installed close to load to improve power factor

Basic producers — large, medium, or small — can bring power to unit processes more economically and use it more efficiently, for a net increase in production and reduction in power cost.

One company, in cooperation with Westinghouse Engineers, planned an electrical package from power supply to furnace that did just that.

The first important step was to bring furnace transformers as close to utilization points as possible, so that secondary leads were short. Resulting high power factor cut energy costs considerably. The furnace is operated at high voltage close to the load, providing electrical efficiency approximately 10% higher than usual.

The Westinghouse Shell-type Transformer is basically a far better performer, electrically and mechanically, for applications such as this where electrical equipment must stand the terrific punishment of cyclic loading and high current surges. Westinghouse Shell Transformers are more compact, provide better cooling, are gas and moisture tight. Maintenance is lower.



Westinghouse Type AU Balanced Beam Regulator provides automatic operation and accurate control of energy to furnace

The second major step in this installation was the choice of the Westinghouse AU Regulator as the furnace control system. This regulator balances are voltage and current to maintain the desired power input set by the operator, consistently and precisely.

If furnace conditions change, position of electrodes within the charge is automatically changed to maintain the current pre-set by the furnace operator. The Type AU Balanced Beam Regulator was the first arc furnace control which measured both arc current and voltage in positioning electrodes and is the only balanced beam type now available.

The Type AU Regulator acts fast to correct cur-

rent unbalance but doesn't overshoot or hunt. The sensitivity can be adjusted to suit particular furnace conditions. Properly applied and adjusted, the Type AU regulator will maintain electrode position to insure maximum continuous protection from chemical arc furnaces. It is particularly adaptable to use with automatic power regulating systems.

Westinghouse Type AU Balanced Beam Regulator is recommended as the most suitable and economical for most chemical arc furnace applications. For the few applications where a rotating regulator is desirable, the Westinghouse Rototrol® is available.

YOU CAN BE SURE ... IF IT'S Westinghouse



One man and dependable Westinghouse Ignitron Rectifiers run this chlorine line

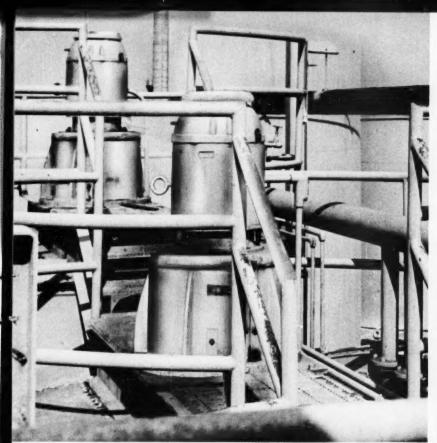
As this basic chemical producer has found, Westinghouse Ignitron Rectifiers bring a new standard of performance—high power conversion efficiency and low cost to electrolytic processes using power in the 250-3000 voltage range. The chlorine gas operation at this plant is comprised of 180 cells, connected in series, at 650 volts, and is served by a bank of 48 rectifier units.

The Ignitron Rectifier, developed by Westinghouse, introduces a basically new principle in the utilization of rectifying properties of the mercury vapor arc. At higher voltages, it is undisputably more efficient than motor-generator sets or rotary converters. Production cost savings are proportionally greater as voltages increase and, of course, as ratio of electrical energy per ton of finished product increases.

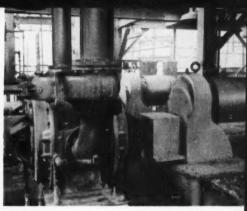
Operating headaches are eliminated, too—Ignitrons can be set up easily for automatic unattended operation. Availability of 99% or better in Ignitron installations often eliminates the need for stand-by equipment. Complete absence of moving parts drastically cuts maintenance. Ignitrons are inherently easier to protect against corrosion than any comparable rectifying equipment.

Westinghouse Ignitron Rectifiers offer you an unequaled opportunity for continuous throughput at rock-bottom cost.





Life-Line Gearmotors, serving salt removal tanks, give automatic processing a boost with dependable, round-the-clock operation.



Life-Lines driving water recirculating pumps.



Westinghouse Control Center banks motor controls away from exposed production areas.

G

Gearmotors give vital 24-hour reliability driving pumps on salt removal tanks

Dependable, continuous circulation of tremendous amounts of water is critical in this plant. For the job, Westinghouse Gearmotors were chosen.

Both gear unit and motor in these compact units incorporate features that assure continuous service with a minimum of maintenance required. Accurately hobbed, specially treated gear teeth absorb heavy operating shocks and prevent damaging vibrations. Westinghouse Gearmotors have positive shaft sealing to prevent leakage of oil and entrance of foreign matter.

The Life-Line® Motor, an integral part of the gearmotor, is pre-lubricated—new 4-way seal bearings provide a continuous supply of motor grease without leakage and, above all, keep dust and dirt out. Westinghouse Control Centers locate control conveniently for emergencies, away from danger areas

For power or light, Westinghouse Control Centers offer the modern way to group motor starters in centralized, planned-away-from-production areas. They are particularly suitable in plants where atmospheres are heavily laden with dust or chemical gases. Maintenance people can get at them quickly and easily.

Individual control cubicles can be removed or replaced in a few minutes. Each unit is safely insulated from its neighbors.

YOU CAN BE SURE ... IF IT'S Westinghouse

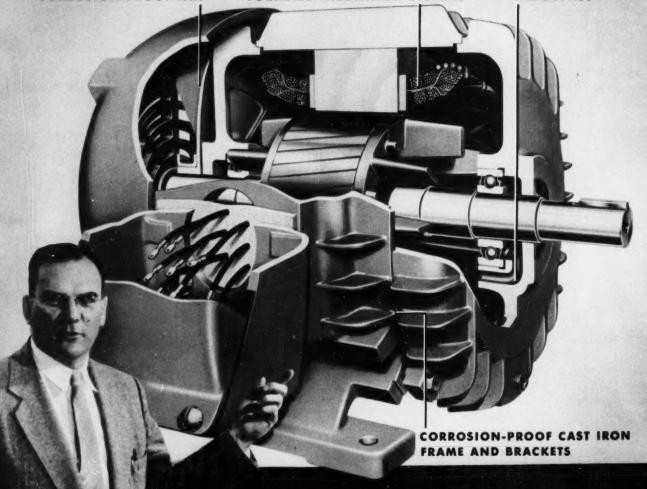


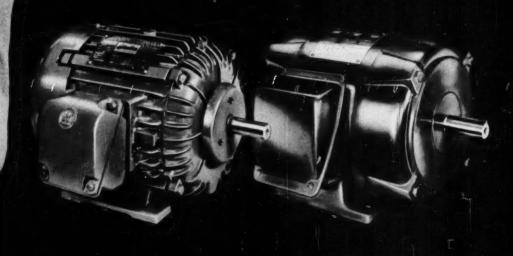
New Life-Line A motor in CAST IRON,

CORROSION-PROOF FAN

FORTIFIED INSULATION SYSTEMS

AIR BYPASS





and matching control for corrosion resistance, more production

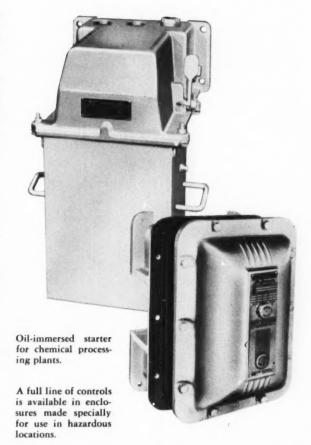
Setting big, new standards of performance is the new Westinghouse Life-Line "A" better-protected Motor. Here is a power package that is physically smaller, mechanically stronger and electrically longer lasting than any conventional motor.

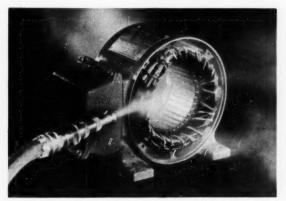
Two basic models for all chemical plant applications—the dripproof for outdoor or other similar applications, and the totally-enclosed fan-cooled for corrosive applications—will assure you the same field-proved electrical performance Life-Lines have always given, but now in CAST IRON to withstand ravages of corrosive atmospheres. For 7-day week production, you now get:

- Better protection for the lubrication system new 4-way seal bearings, with double seals on each side of the bearing, effectively stop contamination. You still get the proved principle of prelubrication which prevents overgreasing or wrong grease—plus extra protection.
- New fortified insulation: Mylar*, a slot insulation
 with greater dielectric and mechanical strength;
 Bondar, a wire insulation with more heat resistance; Bondite, a stator insulation with greater
 strength to withstand destructive elements.
- New armorized enclosure, in CAST IRON, gives you even better protection against corrosion from chemicals, liquids or dirt, as well as protection against physical impact, and can be located anywhere and in any position.

Rating for rating, horsepower for horsepower, the new Life-Line "A" Motor is the finest longdistance performer you can buy.

*DuPont Registered Trade-Mark

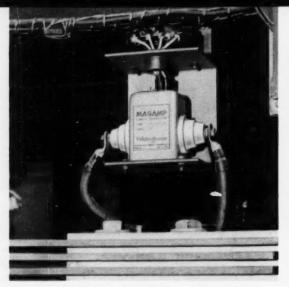




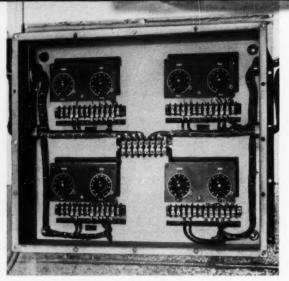
Life-Line's fortified insulation system provides higher thermal stability; resists moisture, oils, chemicals.



Here's a dust storm no motor will ever have to go through. Life-Line 4-way seal bearings stand up in any atmosphere.



Westinghouse Magamp, transductor type, measuring amperage on a chlorine line.



Control panel serving Magamp unit.

Compact Magamp provides dependable check on d-c amperage consumed by Ignitron Rectifiers

A basic new regulating system, illustrated here on the chlorine line, is not only simpler and more compact than mechanical or rotating types, but is highly versatile as well. In this application, Westinghouse Magamp is used to totalize d-c amperage used in the banks of Ignitron Rectifiers.

Whether utilized for control of tension, voltage, current or speed, Magamp acts swiftly, accurately. Disturbances are instantly eliminated. Despite its small size and quick judgment, Magamp is ruggedly built, insensitive to normal shock and vibration. It has no moving parts—commutators, brushes, bearings—to wear, no tubes to burn out. It is a static device, and as such requires virtually no maintenance. Original resistor settings, made when the unit is installed, are permanent. Magamp is at your service and ready to go at the flip of a switch—no warm-up time needed.

For a low-cost production tool with high reliability in continuous operation processes, specify Westinghouse Magamp.

Westinghouse engineering can help you save power with the right combination of equipment

The most efficient, productive way to apply electrical equipment to arc furnaces or chemical processing lines is in an integrated system. Westinghouse builds all the necessary equipment, designed to work together. Why not put Westinghouse experience to work for you? Call us in early in the planning stage.

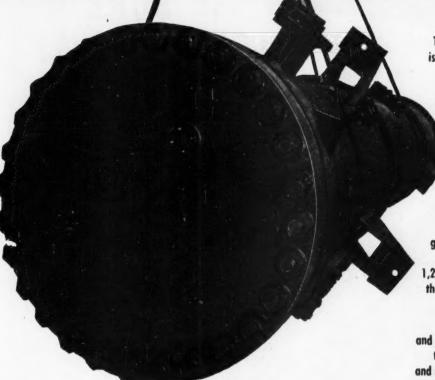
Inspection and repair needs are answered promptly by Westinghouse maintenance

Another important link in economical power supply can be the nationally recognized Westinghouse Maintenance and Repair Service, operated on the local level for fast—even emergency—service. To keep your plant producing, Westinghouse offers: equipment repair or reconditioning in 38 plants; inspection and on-the-spot repairs for equipment that cannot be moved easily through 56 field service offices; fast delivery of genuine Westinghouse Renewal Parts from stock in 31 locations.

MP-3028

For product literature, check the coupon below, and mail to Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh	o Westinghouse Electric
 ☐ How to Get the Most Out of Arc Furnaces ☐ Life-Line Gearmotors ☐ Speed Reducers ☐ The New Westinghouse Control Center ☐ The New Life-Line "A" Cast-Iron Motor ☐ B-6154 	□ Motors & Controls in the Chemical-Processing Industries B-4792 □ Power for Electrolytic Processes B-5466 □ Preventive Maintenance B-5477 □ How to Select AB Circuit Breakers B-6141 □ Planning Circuit Protection with Breakers B-6145
Westinghouse W	Name

KING SIZE



This giant 37 ton Cat Poly Reactor is one of 4 units shipped to a large petroleum refinery in the State of Washington. It is 4'-31/2" in diameter by 32'-0" long and has a 13/16" thick shell. Each of its 8" thick heads is attached to the shell channel with 28 special alloy stud bolts 23/4" diameter by 151/4" long having nuts 41/4" across the flats. Into the 53/4" thick tube sheets 190 tubes, 21/2" O. D., No. 5 gauge and 30'-0" long, are rolled and seal welded. Designed for 1,230 lbs. pressure on the tube side, the reactor was completely X-rayed and stress relieved.

Vogt, a leading builder of shell and tube reactors for poly plants, has the competently skilled personnel and modern mechanical facilities with which to provide heat transfer equipment for the most exacting services in petroleum refineries, chemical plants, and related industries.

Reactors
...by Voqt

A bulletin describing the wide range of heat transfer equipment built by Vogt is available upon request.



HENRY VOGT MACHINE CO., LOUISVILLE, KENTUCKY

BRANCH OFFICES: NEW YORK, CHICAGO CLEVELAND, DALLAS, PHILADELPHIA ST. LOUIS, CHARLESTON, W. VA.

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NEW VEELOS

TD and TE Adjustable V-belts

for D and E Drives

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...<u>easier</u> to couple and uncouple ...longer lasting

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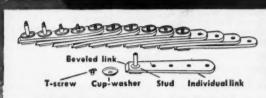
090

Now get the v-belt that's been especially developed for D and E drives—the new, patented Veelos TD and TE adjustable v-belt!

This new Veelos has advantages unmatched by any other v-belt. It is installed quickly without removing the outboard bearings found on most D and E drives. It is the easiest v-belt to couple and uncouple ever developed. Cup-washers and T-screws join links together to form individual belts of any length. Veelos TD and TE lasts longer because new high-tensile strength links plus the new stud, cup-washer and T-screw design give added strength—combines this added strength with maximum flexibility for cooler, smoother running.

Install this new Veelos TD and TE v-belt on your D and E drives. Prove to yourself why there's no v-belt that can match the performance, the efficiency and the economy of Veelos TD and TE.

Get the complete story of this great new v-belt for D and E drives. Send the coupon now for new 8-page illustrated catalog.



This detailed line drawing of the new Veelos TD and TE v-belt makes it easy to see how this new v-belt is designed to do a better job...easier!



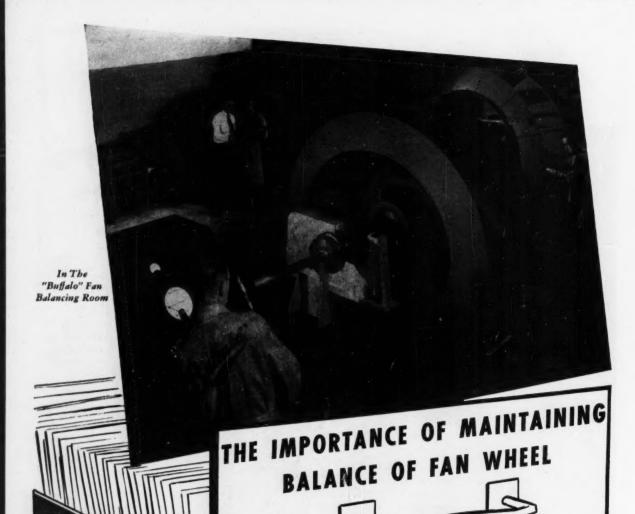
MANHEIM MANUFACTURING & BELTING CO. 602 Manbel St., Manheim, Pa.

Please send copy of your new Veeles TD and TE v-belt catalog.

Name.....

Company

ADJUSTABLE TO ANY LENGTH . ADAPTABLE TO ANY DRIVE



PROBLEM:

excessive vibration in exhaust fan delivering dust-laden air to cyclone. Fan operated smoothly a number of years, but gradually developed vibration and finally damaged the bearings.

SOLUTION:

Fan Wheel found to be far out of balance due to uneven buildup of slightly moist dust particles on blades. Fan rotor had never been cleaned, and had condition been permitted to continue, further bearing troubles and a sprung shaft might have resulted. "Buffalo" representative advised owner to clean rotor every six months, then check wheel balance, Fan has since operated smoothly, with no further bearing

trouble, and at greatly reduced noise level. NOTE: all "Buffalo" fan rotors are balanced both statically and dynamically on precision balancing machines at the factory. Regular periodic cleaning and repainting followed by a balance check will assure added years of smooth, efficient performance.

This is one of the thousands of problem-solution case histories accumulated in "Buffalo" files during our 77 years of building air handling equipment and solving air problems for industry. Call your nearest Buffalo Engineering Sales Representative—get the benefit of his factory trained "know-how" and experience to help you solve your air problems.

Write for Maintenance Data Booklet 3426.

BUFFALO FORGE COMPANY

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Publishers of "Fan Engineering" Handbook

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

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VENTILATING FORCED DRAFT AIR CLEANING COOLING AIR TEMPERING HEATING INDUCED DRAFT PRESSURE BLOWING EXHAUSTING



Testing with variable A-C Voltage?

THE OLD WAY:

Collect 1. A variable transformer

- 2. A voltmeter
- 3. Connection leads and then connect

THE NEW WAY: Get all at once in a

VOLTBOX A.C. POWER A.C. SUPPLY

Here's your variable a-c voltage test gear all ready in a compact, castaluminum, portable unit that includes:

- A POWERSTAT variable transformer
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Save your own valuable time and do a better job with a VOLTBOX a-c power supply.

See the Superior Electric's Mobile Display when in your area Four types of VOLTBOXES to meet your needs:

Туре	Input Volts	Frequency	Output Voltage Range	Output Current (Amps.)
UCIM	120	50/60	0-140	7.5
UC2M	240	50/60	0-280	3.0
U-2000	120	50/60	0-140	20.0
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THE

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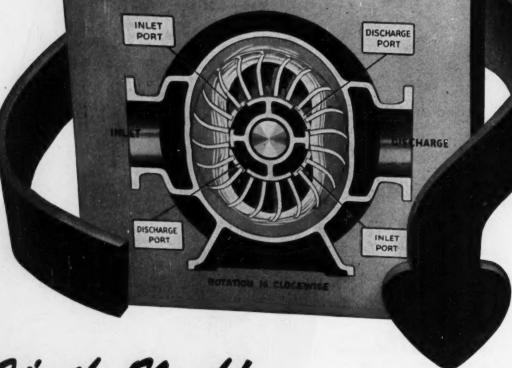
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This is Why the Nash is the Most Simple Compressor



It's the Nash!

There are no mechanical complications in a Nash Compressor. A single moving element, a round rotor, with shrouded blades, forming a series of buckets, revolves freely in an elliptical casing containing any low viscosity liquid. This liquid, carried with the rotor, follows the elliptical contour of the casing.

The moving liquid therefore recedes from the rotor buckets at the wide part of the ellipse, permitting the buckets to fill with gas from the stationary Inlet Ports. As the casing narrows, the liquid is forced back into the rotor buckets, compressing the gas, and delivering it through the fixed Outlet Ports.

Nash Compressors produce 75 lbs. pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure. Since-compression is secured by an entirely different principle, gas pumping problems difficult with ordinary pumps are often handled easily in a Nash.

Nash simplicity means low maintenance cost, with original pump performance constant over long periods. Data on these pumps sent immediately on request

No internal wearing parts.

No valves, pistons, or vanes.

No internal lubrication.

Low maintenance cost.

Saves floor space.

Desired delivery temperature automatically maintained.

Slugs of liquid entering pump will do no harm.

75 pounds in a single stage.

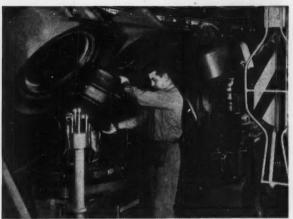
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Paint, Varnish and Lacquer



Motor Oil and Gasoline (Additives)



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You get proved results when you use

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Acetone
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Ethyl Ether
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Dicyclopentadiene
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Decyl Alcohol
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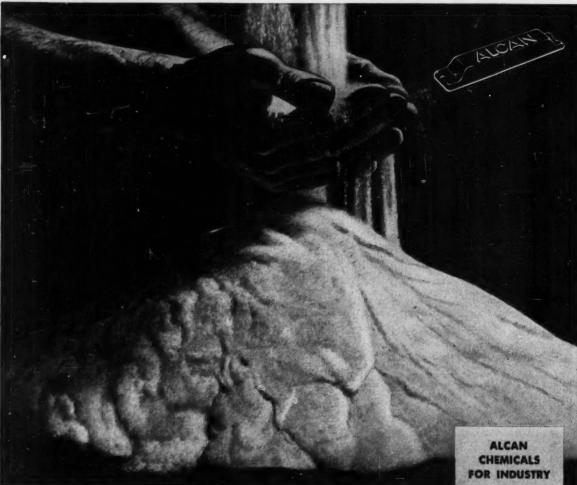
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Depend on the Enjay Company for a complete line of petroleum chemicals backed by research, experience, know-how and proved results. Enjay is a recognized leader in developing and marketing uniform, high quality chemicals for the petroleum, surface coating and chemical industries.

Not only does Enjay supply a constantly growing list of petroleum chemicals to an increasing number of industries — Enjay is also ready to assist in developing new or improved products through chemistry. For proved results, make it *your* business to specify Enjay.

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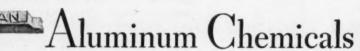
What's Alcan doing in Chemicals?

As THE PRODUCER of one-fourth of the free world's aluminum, Alcan (Aluminum Company of Canada, Ltd.) is concerned with chemicals in a big way. With a large range of metallic and non-metallic products, evolving from the production of aluminum, Alcan is in a position to supply chemicals to industry for a variety of uses.

These Alcan Chemicals have to be good and you can depend on it—they are. Cooperating in their production are Alcan's sister companies. Each of these affiliates specializes in its own field of endeavor:

- Laboratory research, and the exploring and surveying of material resources throughout the free world;
- Mining and processing of raw materials in many different countries;
- Development of up-to-date shipping methods for the protection and speedy delivery of the products.

One of Alcan's sister companies, Aluminum Import Corporation, distributes Alcan Chemicals in the United States. The Import office near you will be glad to help you with your special chemical requirements.



Alumina, Activated Alumina, Calcined Alumina Hydrate Aluminum Chloride, Anhydrous Aluminum Fluoride Aluminum Sulphate

Bauxite Chlorine, Liquid Cryolite, Artificial

Fluorspar Lime

Magnesia

Magnesium Chloride, Anhydrous Sodium Fluoride

Sulphuric Acid

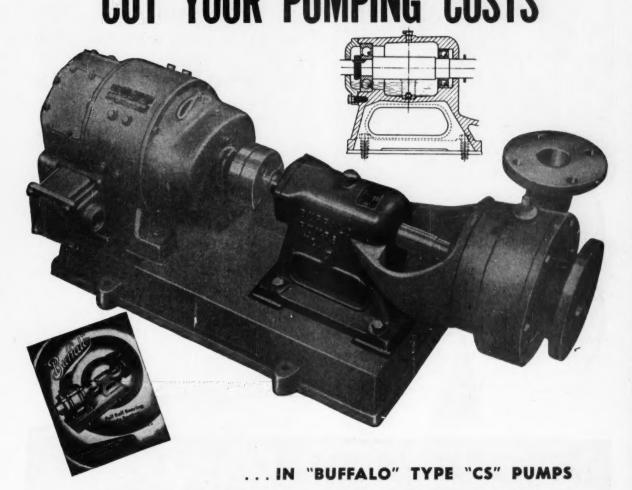
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Smooth, Rugged BEARINGS CUT YOUR PUMPING COSTS



Oversize, durable bearings in a pump can save you money two ways. First, these bearings in the "Buffalo" Single Suction Pump above are capable of handling speeds up to 5,000 r.p.m., which is more than adequate for the most severe strains which constant operation can impose on the pump shaft. This super-endurance saves you money where it counts — in pump repairs.

Secondly, a pump capable of standing high speeds can be ordered in smaller sizes. And this means substantial savings in first cost. But the real savings in "Buffalo" Type CS Pumps are in PERFORMANCE... on your clear water job... on zone air conditioning service... on a wide variety of chemical liquids. WRITE FOR BULLETIN 976D for details on this lower cost pumping!



BUFFALO PUMPS, INC.

501 BROADWAY

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Subsidiary of Buffalo Forge Company

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A RETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

CHEMICAL ENGINEERING-July 1954

47





FAIRBANKS-MORSE

a name worth remembering when you want the best

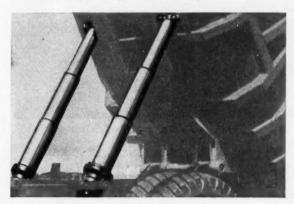
SCALES . PUMPS . DIESEL LOCOMOTIVES AND ENGINES . ELECTRICAL MACHINERY RAIL CARS . HOME WATER SERVICE EQUIPMENT . FARM MACHINERY . MAGNETOS

There's no limit to what you can do with the right tubing!



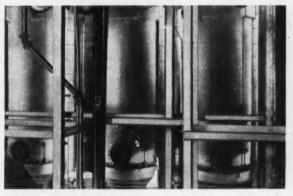
make power to light a city . . .

There are more than 12 miles of Globe seamless pressure tubing (carbon, alloy, and stainless) in this modern boiler which is a vital part of the electric power plant that serves a large metropolitan community.



or lift a load of dirt . . .

Mounted on a dump truck, these twin hydraulic hoists are built to handle heavy loads. Design and production is simplified by making the telescoping arms of Globe mechanical tubing.



transfer corrosive liquids . . .

Black liquor, used in production of kraft papers, is highly corrosive and has to be carried under pressure in multiple effect evaporators. Gloweld (electric welded) Stainless Steel Tubing was found to do the job best—at lowest cost.

There are probably a thousand and one different tube applications that could be made in your own products or industry. Check the possibilities. Globe engineers will be pleased to give helpful advice on how the right tubing — Globe tubing — can help you save time, save money, save manpower. Write for literature on any of these products.



CLOBE STEEL TUBES

GLOBE STEEL TUBES CO.

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Field Offices: Chicago • Cleveland • Detroit • New York Philadelphia • St. Louis • Denver • Houston San Francisco • Glendale, Calif.

-A quick check list of GLOBE STEEL TUBES-

ALLOY STEEL: to meet heat, corrosion, pressure, and structural strength problems. Carbon Moly, Chrome Moly Nickel and others. Sizes: O.D. from ½ to 6 inches. Wall thickness .035 to 1.000 inch.

CARBON STEEL: for load bearing structural members with strength, least weight . . . for fast, low-cost manufacturing of machine parts or pressure tubing applications. Low and medium carbon. Sizes: O.D. ½ to 7½ inches. Wall thickness: .028 to 1.000 inch.

STAINLESS SEAMLESS: in sizes from ½ inch to 6 inches O.D., and in pipe sizes 1½ inch to 6 inches, standard, extra strong and double extra strong weights.

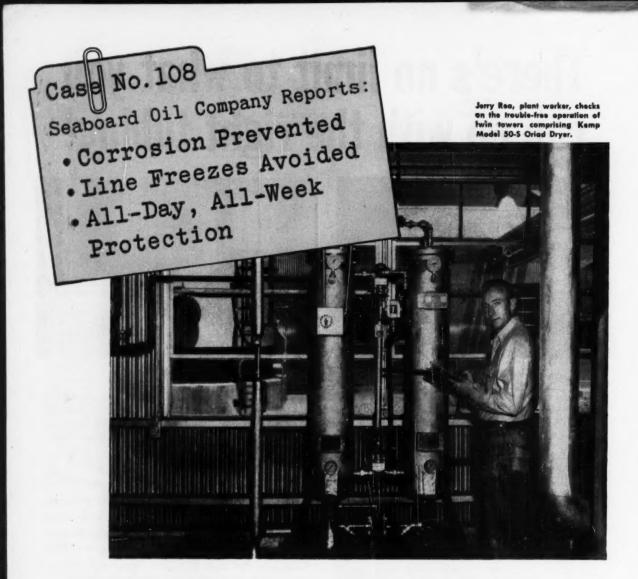
STAINLESS WELDED: Gloweld electric welded stainless steel tubing offers many economies. Sizes: O.D. ½ to 5 inches. In standard wt. pipe sizes ½ to 2 inches. In lightweight pipe sizes ½ to 4½ inches inclusive.

HIGH PURITY IRON: Globeiron tubing is 99.5% pure ingot iron. For applications where ductility, toughness, easy

weldability and easy forming are desired or for use where magnetic permeability and electrical properties are required.

SPECIAL ANALYSES: Globe Steel Tubes Co. regularly produces tubing to special customer specifications. Consult with Globe's representatives for analyses to suit your needs.

GLOBE WELDING FITTINGS: seamless, carbon and stainless, available in a complete line of sizes and weights through Globe distributors in key cities.



Sulphur Producer Gets Automatic Drying of Compressed Air with Kemp

During their processing of sulphur and sweetening of natural gas, the Powell, Wyoming, plant of Seaboard Oil Company of Delaware needs large quantities of dried, compressed air to operate complex control instruments.

When their Silvertip Field plant was opened, the operators turned to Kemp to provide this dried air, installing a Model 50-8 Kemp Dryer. The machine operates on a manual switching and automatic timing device. Imbedded steam coils reactivate the towers... permitting 25 cfm capacity at an exit pressure of 50 psi. The installation is operating 24 hours a day on a seven-day week—preventing corrosion and avoiding

costly delays caused by line freezes in the plant.

If drying air or other gases is a problem in your operation, it will pay you to discuss your problems with a Kemp Engineer. He can recommend specific equipment to handle your specific problem . . . and give you the benefits of every Kemp installation—simplicity of operation and maintenance, low installation cost and minimum maintenance expense. A Kemp Engineer is ready to discuss your needs—without obligation.

For detailed, technical information, ask for Bulletin No. D-29. Write to: C. M. KEMP MFG. CO., 405 E. Oliver Street, Baltimore 2, Maryland

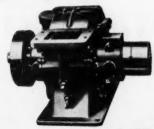
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ADSORPTIVE DRYERS

ATMOSPHERE & INERT GAS GENERATORS SINGEING EQUIPMENT-IMMERSION MELTING POTS CARBURETORS - BURNERS - FIRE CHECKS

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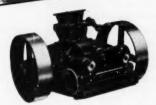
LABORATORY SWING-SLEDGE MILLS

Capable of reducing soft, moderately hard and tough or fibrous materials to any degree of fine-"Open-Door" feature permits ready accessibility for cleaning.



LABORATORY JAW CRUSHERS

Special Roll Jaw action simplifies close regulation of the product with capacities varying from 300 to 400 lbs. per hour at finest settings, to 1000 or 2000 lbs. when opened for coarser work. Each part of the crusher is accessible for quick and easy cleaning.



LABORATORY CRUSHING ROLLS

First designed especially for laboratory sampling work, Sturtevant Crushing Rolls are used regularly in many plants where there are limited out-puts. Range of output for the 8 x 5 size is from 1/2 in. to 20 mesh — and for the 12 x 12 size from 3/4 in. to 20 mesh.

Laboratory Equipment...

assures accurate samples...cuts laboratory sampling costs

Sturtevant laboratory equipment have all the features of full-sized production machines with extra accuracy and wider range of adjustment built-in. They are fast . . . provide true samples of every batch processed.

All Sturtevant machines have "open-door" accessibility which permits quick, thorough cleaning . . . prevents the possibility of previous batches from contaminating new samples. Their rugged construction assures round the clock operation with practically no maintenance.

Investigate Sturtevant equipment for your laboratories. They will help you cut sampling costs ... improve product quality ... increase sales. Write for catalog, today.



LABORATORY SAMPLE GRINDER

Laboratory Sample Grinders are of the "Open-Door" disc type and are capable of very fine work, producing products as fine as 100 mesh (coarser if desired) when working on dry, friable, soft or moderately hard materials. Simply turn hand wheel to provide product regulation from 10 to 100 mesh.

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LARGEST...

Most Modern Light Aggregate Plant USES VULCAN ROTARY KILNS

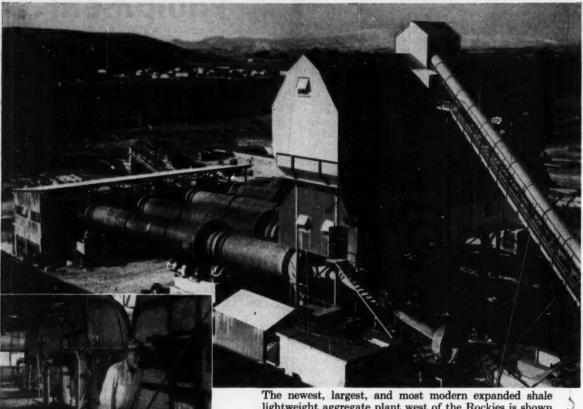


Illustration above shows the four firing hoods which are adapted for both gas and oil.

Any information on items listed below will be sent to you immediately:

Rotary Kilns, Coolers and
Dryers,
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Improved Vertica! Lime Kilns
Automatic Quick-Lime
Hydrators
Double-Roll Briquetting
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Shaking-Chute and Chain Conveyors Heavy-Duty Electric Hoists Self-Contained Electric Hoists Scraper-Loading Hoists Cast-Steel Sheaves and Gears Steam Locomotives Diesel and Gasoline Locomotives Diesel-Electric Locomotives The newest, largest, and most modern expanded shale lightweight aggregate plant west of the Rockies is shown above. It is one of the fifteen plants operated by The Basalt Rock Co., Inc., of Napa, California. This new plant is now in full operation and is producing "New Basalite" at the rate of 700 cubic yards daily.

This plant, which is the last word in design and efficiency includes four VULCAN 8' x 125' all-welded Rotary Kilns. Each kiln has two tires, and is driven by a 20 hp varidrive motor with a standby diesel-driven generator, in case of power failure. The four VULCAN Kilns are gas fired, and in case of an emergency are also adapted for use with oil.

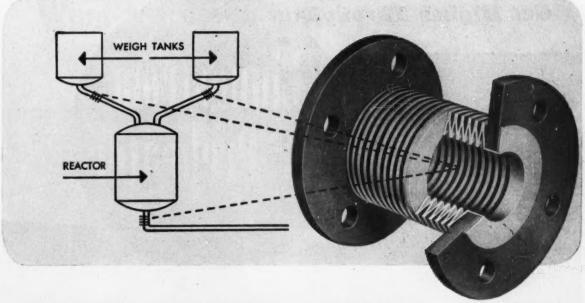
Each and every part of all VULCAN Kilns are precision designed, precision built to give you maximum protection against mechanical troubles of all kinds. The VULCAN IRON WORKS of WILKES-BARRE, and its 105 years of experience are ready and willing to give you information on Rotary Kilns for any application. Write for detailed and fully illustrated Bulletin No. A-442 today.

VULCAN IRON WORKS

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CABLE ADDRESS



Expansion joint bellows of Du Pont "Teflon" protect your costly process equipment

- · Resist chemical attack
- · Are non-contaminating
- Correct misalignment
- Are unaffected by high temperatures

Du Pont "Teflon"* tetrafluoroethylene resin is a versatile engineering material for the chemical processing industry. Chemically inert to all acids, alkalies and organic solvents, is affected only by molten alkali metals and fluorine at elevated temperatures and pressures. Used as a bellows for expansion joints, "Teflon" is flexible, yet strong. This flexibility compensates for misalignment between connections in pipes joining

tanks, pumps or reactors, absorbs vibration, and allows equipment parts to expand and contract safely.

"Teflon" is non-contaminating. Service temperature range is from -450°F to 500°F. "Teflon" is not eroded by impinging fluids. Products made of "Teflon" give dependable service and long service life.

Have you and your company investigated the properties of Du Pont "Teflon" and the other members of the Du Pont family of plastic engineering materials—"Alathon" polyethylene resin, "Lucite" acrylic resin and Du Pont nylon? The application described above is typical of the product improvements made possible when design and service requirements are evaluated in terms of the properties of these unique engineering materials. For further information on the properties and uses of these materials, maif the coupon below.

(Expansion joints manufactured by United States Gasket Co., Camden, N. J.)

*TRADEMARK OF E. I. BU PONT DE NEMOURS & CO. (INC.



E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department Room 255, Du Pont Bldg., Wilmington 98, Delaware.

Please send me more information on the Du Pont plastic engineering materials checked: _ "Teflon" tetrafluoroethylene resin; _ "Alathon" polyethylene resin; _ DuPontnylon; _ "Lucite" acrylic resin. I am interested in evaluating these materials for...

Title_______

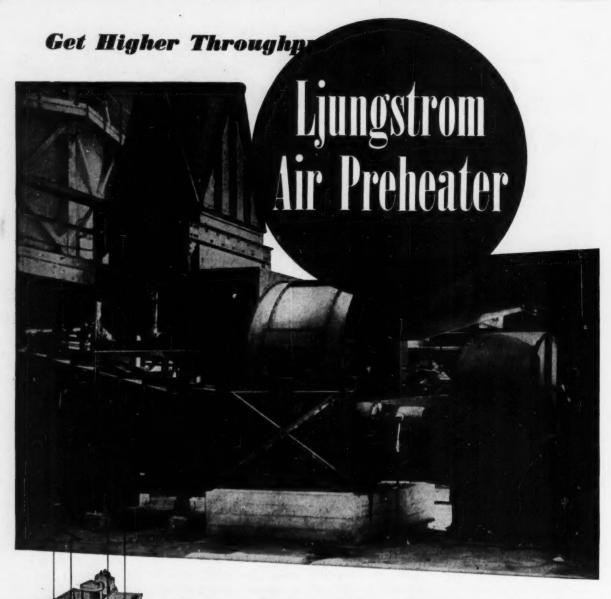
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Type of Business______



The Ljungstrom operates on the continuous regenerative counter-flow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming cold air.

With the process industries' production at all-time high levels—and climbing higher—here is a timely suggestion that may point the way to significant production increases in your plant—without adding a single still.

A Ljungstrom Air Preheater, properly combined with modern draft and burner equipment, can increase still production as much as 25%. At the same time, plugging is so much reduced that production lost to downtime will be astonishingly low.

The value of the Ljungstrom Air Preheater lies in its ability to recover heat normally lost up the stack, and to return a large portion of it to the furnace zone in the form of preheated combustion air. Fuel requirements are drastically reduced and—where furnace capacity permits—throughput goes up considerably.

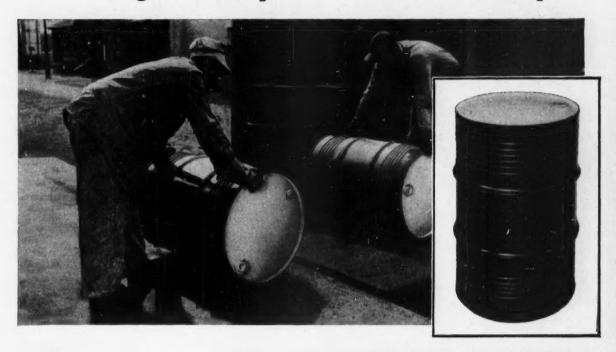
Furthermore – the finer temperature control possible leads to closer control of the end product. This alone can mean tens of thousands of dollars a year.

Wherever you are replacing, modernizing, or adding new equipment that burns fuel—consider the economies you can get with a Ljungstrom. Call or write The Air Preheater Corporation for complete information.

Wherever You Burn Fuel, You Need Ljungstrom

THE AIR PREHEATER CORPORATION 60 East 42nd Street, New York 17, N. Y.

Want to carry quality control right into your customer's shop?



You can ... with USS STEEL DRUMS

There's no need to stop quality control when products leave your plant. With USS scale-free, rust-inhibited Drums you can carry it all the way... when your customer is ready to use your products, they will be as clean and uncontaminated from scale, dirt, grease and rust as when they were packaged.

Whether your products are to be shipped long distances, stored for a long time, or both, their quality is well guarded in safe, sturdy USS Steel Drums: They're safe because a tight rust-resisting coating is applied over a surface that's been completely cleaned. They're sturdy because they're made of high-grade USS Steel. USS Steel Drums are better for you... better for your customers.

United States Steel Products fabricates stainless, galvanized, tinned, painted and decorated drums and pails. Furnished in a wide range of capacities with a variety of fittings and openings to fit your particular requirements.

UNITED STATES STEEL PRODUCTS

UNITED STATES STEEL CORPORATION
DEPT. 274, 30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.
Los Angeles and Alameda, Calif. Port Arthur, Texas - Chicago, Ill.,
New Orleans, La. - Sharon, Pa.

Write for free brochure

For additional information on this quality steel drum write to us at New York for this full-color brochure, "USS Drums-100% Scale-free and Rust-inhibited."

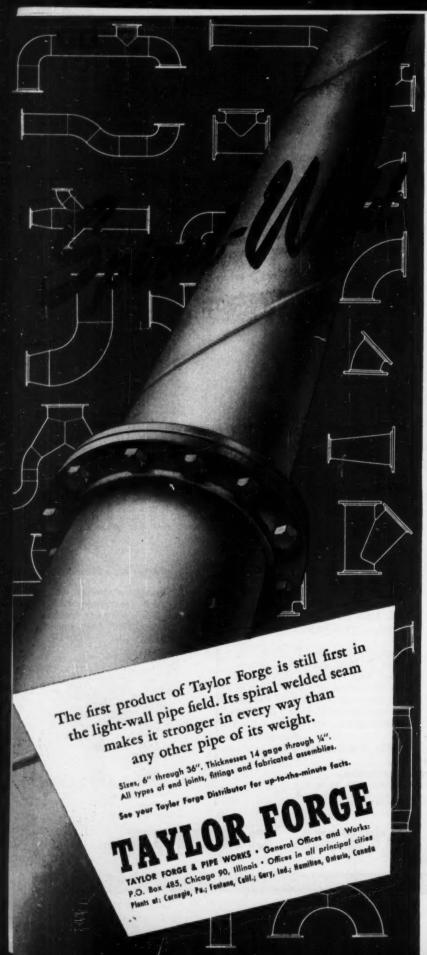


"It's Better to Ship in Steel"



USS STEEL DRUMS

UNITED STATES STEEL





Taken in 1905 ...

This faded photo was snapped five years after Taylor Forge started back in 1900. That line-up of old timers were putting on a convincing demonstration of the first Taylor Forge product—"Taylor's Spiral Riveted Pipe."

The clothing and hat styles may be dated, but not the pipe. Taylor Spiral Pipe (now welded instead of riveted) then was, and still is, the strongest pipe of its weight.

But while the pipe itself proved revolutionary, the only flanges then available for it—cast iron flanges—were not up to the standard of the pipe. The iron flanges often cracked and caused trouble...and since Taylor Forge couldn't get better Flanges, Taylor Forge decided to make better flanges.

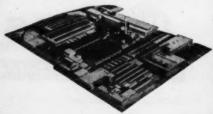
So in that long-ago Taylor Forge set up facilities for making forged steel flanges. It was a pioneering step ... the first time forged steel flanges had been made on a commercial scale. It was also a turning point... for it marked the transition from simply making pipe into the field of designed piping.

An episode in the story of Taylor Forge leadership in designed piping



We started here in 1900.

One of the five Taylor Forge plants of today is shown below.



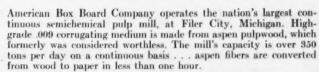




Michigan's vast aspen forests were once considered worthless for papermaking.

Today, American Box Board converts these same trees into fine corrugated paperboard.

How Wyandotte Soda Ash helps get good pulp from aspen



"Since the opening of our Filer City plant, Wyandotte has supplied us with soda ash for the making of sodium sulphite," says Rowland L. Hall, purchasing manager. "We have always found Wyandotte products to be of uniform quality, and their service to be prompt.

"The paper industry is closely allied to the chemical industry. Technical service and an interchange of ideas are vital. Wyandotte helps us both ways."

Whether you use soda ash in the manufacture of glass, chemicals, soap, textiles, dyes, or what have you, you'll find Wyandotte a reliable source.

Wyandotte can supply you with many other organic and inorganic chemicals, along with helpful technical data for using them profitably. If you have chemical or process problems within the scope of our products and manufacturing background, contact us . . . we will be glad to be of service. Wyandotte Chemicals Corporation, Wyandotte, Michigan. Offices in principal cities.



SODA ASH • CAUSTIC SODA • BICARBONATE OF SODA • CHLORINE • CALCIUM CARBONATE
CALCIUM CHLORIDE • GLYCOLS • SYNTHETIC DETERGENTS • AGRICULTURAL INSECTICIDES
SOIL CONDITIONERS • OTHER ORGANIC AND INORGANIC CHEMICALS





Eye Protection



THE EYES OF TEXAS

Petro-Chemical Workers and Others are Protected with this Gas-Tight AO Rubber Frame Goggle

wherever gases, fumes and smoke are hazards you'll find this AO 701 Rubber Frame Goggle made for the job. It seals the entire eye area tightly and may be worn over personal glasses. You can rely on this goggle — one of a complete line for industry, made by the world's largest manufacturer of personal safety equipment and ophthalmic devices. Your nearest AO Safety Products Representative can supply you.

QUICK FACTS

Frame molded from non-irritating, acid-resisting neoprene.

Completely gas-tight — no ventilation slots in frame, no hole for strap in lenses.

Acid-resistant bolts and nuts on front of frame.

Large vinylite lens conforms to high optical standards, offers exceptional wide-angle vision and is easily replaceable.



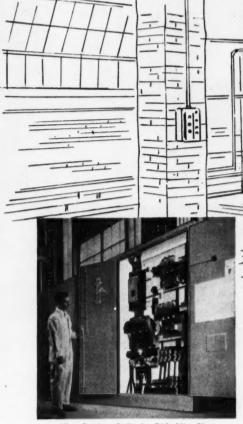
Keep your workers in the Safety Zone with American Optical Safety Equipment

SOUTHERIDGE, WASSACHUSETTS . BRANCHES IN PRINCIPAL CITIES

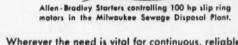
n sewage disposal plants...

it pays to install trouble free

ALLEN-BRADLEY MOTOR CONTROL



Allen-Bradley Bulletin 761 Slip Ring Motor Starters controlling 350 hp motors in the Milwaukee Sewage Disposal Plant.



Wherever the need is vital for continuous, reliable operation, especially in the case of a sewage plant where the public health is involved, it pays to install dependable Allen-Bradley control on all motorized machines and equipment.

Why is this claim for dependability of Allen-Bradley controls justified? In the first place, it is backed by at least 20 years of field experience with the present designs. However, the real answer lies in the simple solenoid design—only ONE moving part—a reliable assurance for millions of trouble-free operations. The double break, silver alloy contacts require no filing or dressing, a timesaving and moneysaving feature... and a blessing to the busy maintenance engineer. Continuously dependable overload relays protect motors, men, and machines, irrespective of what the operating conditions may be.

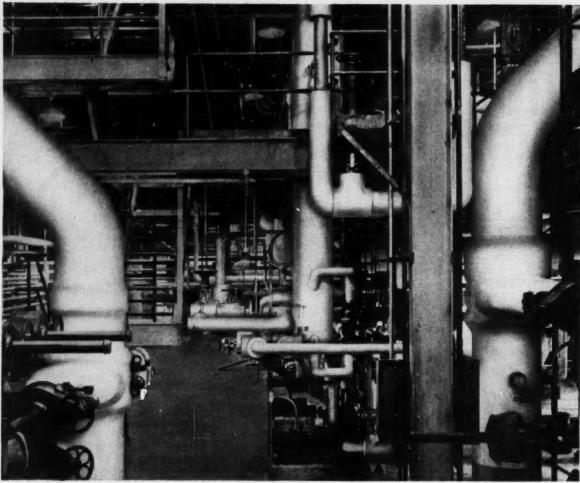
Allen-Bradley has a broad line of motor controls for the chemical and process industries—in special enclosures for all operating conditions. Let us send you the new 120-page "Hundy" catalog—it is full of information that can be useful to you!

Allen-Bradley Co. 1337 S. First St., Milwaukee 4, Wis.

ALLEN - BRADLEY SOLENOID MOTOR CONTROL

The Sign of Quality in Motor Control





Extraction unit and piping insulated with "Featherweight" 85% Magnesia. Sabrooke Plant, Rockford, III., of the Central Illinois Electric and Gas Co. Insulating Contractor: Standard Asbestos Manufacturing Co., Chicago

Featherweight 85% MAGNESIA

The Sabrooke Plant of the Central Illinois Electric and Gas Co. (illustrated) is typical of the thousands of installations where "Featherweight" 85% Magnesia efficiently conserves heat.

"Featherweight" 85% Magnesia has for years—more than 60—effectively fulfilled the needs of schools, hospitals, hotels, apartment and office buildings, power plants, factories—wherever efficient conservation of heat is of importance.

"Featherweight" 85% Magnesia is more than efficient.

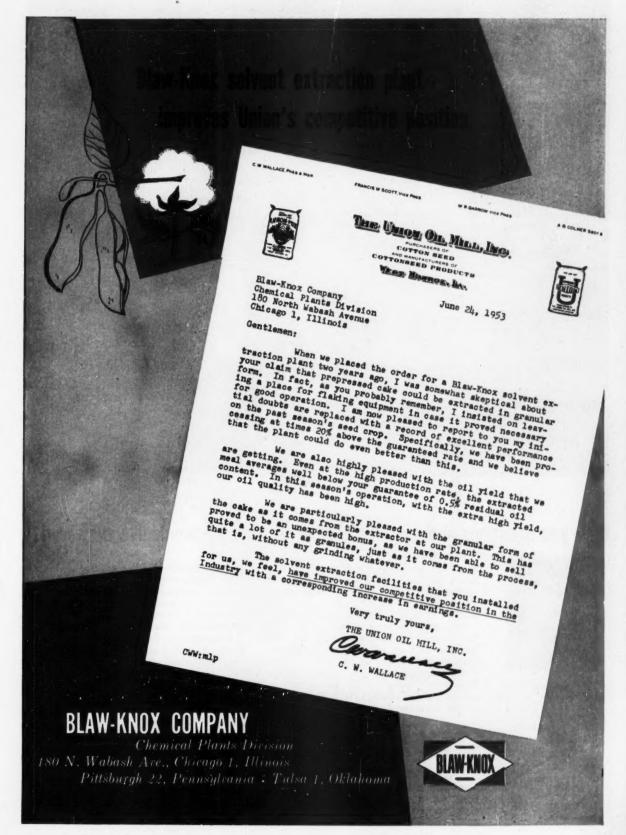
It cannot burn and will not corrode because it is inorganic. It is light in weight and structurally stable. It is made in simplified thicknesses for pipe installations, so that each size and thickness will fit over or into another size and thickness. This is important where two layer thicknesses are desired and for reducing inventories.

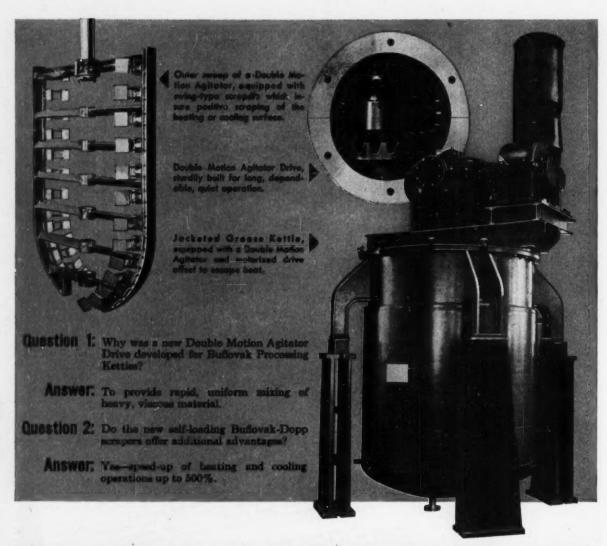
If your company has an insulating problem, the chances are that "Featherweight" 85% Magnesia can help you save heat, save money! Your K&M distributor is an experienced applicator who will gladly give you more information, or write directly to us.

KEASBEY & MATTISON COMPANY . AMBLER . PENNSYLVANIA

Nature made asbestos... Keasbey & Mattison has made it serve mankind since 1873







Have you questions about processing kettles that you would like answered?



For more complete information about Buflovak-Dopp Processing Kettles, write for Catalog 356-R. Most everyone has some questions. And many of them have found the answers through pre-testing their products in our Pilot Plant . . . an important part of the Buflovak Research and Testing Laboratory.

You have the same opportunity to find the answers to your questions, as these facilities and an experienced engineering staff are maintained to help you.

To determine the right answers to better processing, many factors must be considered . . . such as the product, the design of the equipment, the type of agitation, and the handling of the finished material.

To improve your present processing methods or to find the most effective method for new and untried processes, the safest procedure is to process a quantity of the product and observe results.

This accurate data, when gathered and evaluated, will determine the precise equipment needed. Kettles can then be designed and built to most economically and profitably fulfill your expected requirements.

Let us know what questions you have and we'll help you find the answers.

BUFLOVAK EQUIPMENT DIVISION BLAW-KNOX COMPANY

1551 Fillmore Avenue, Buffalo 11, New York



BUFLOVAK PRODUCTS: evaporators • dryers (atmospheric and vacuum) • solvent recovery and distillation equipment • chemical plant equipment • food processing equipment • kettles • fabricated processing equipment • vulcanizers . . . plus a complete Pilot Plant for pre-testing processes and products.

Cuaranteed SHUT TIGHT*

* When equipped with a SECO Metal Seat and Disc on steam service and protected by an approved Strainer, a Spence Regulator is guaranteed to shut tight when the demand for steam ceases.

Expensive steam leaks due to a lack of absolutely tight shutoff are eliminated in Spence Temperature Regulators. Here is why we can make such a guarantee:

First, our temperature regulators are of the single seat design. Seats and discs are made of durable SECO Metal. More than 20 years ex-perience in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

These plus other design features explain why Spence Temperature Regulators function de-pendably and accurately year after year with-out requiring expensive repairs or special attention.

Want more facts? Write for Bulletin T50 giving full details.



SPENCE ENGIN WALDEN, NEW YORK

PELLETING

Check the following pelleting advantages. Relate them to your materials and processes. You may discover new ways to cut your costs and improve your products and your process.

- 1. Pelleting reduces or eliminates the dusting characteristics of materials.
- Pelleting helps preserve original moisture content, chemical analysis and other properties.
- 3. Pelleted materials flow freely, can be binned, sacked, and packaged easily.
- 4. Hard, shiny pellets have greater sales appeal than loose material.
- Densifying materials-in-process through pelleting improves their filtering qualities, permits granulating, and decreases dispersion rate. It also greatly increases density, facilitating storage and shipment.

Such materials as ammonium chloride, insecticide dusts, clay, citrus meal for use as an antibiotic carrying agent, fertilizer, granular hygroscopic products, and many others are often pelleted to great advantage.

Let a Sprout-Waldron Man survey your products and processes—without cost or obligation—with an eye to increasing your profits. Sprout-Waldron's equipment and vast experience in *adaptioneering* pelleters for use in many fields may be of value to you. Write for details!

SPROUT-WALDRON CONTINUOUS PELLETER

This machine produces top-quality pellets in tremendous volumes at reasonable investment and low operating cost. Small and large pellets—even 1" cubes—can be produced in many shapes and sizes. Pellets 3/16" in diameter and 1/4" long can be produced from some materials at capacities of 10 tons or more per hour with only 75 h.p. The advanced features of this machine are unequalled in the industry.

Quiet V-belt drive.

Exclusive hinged die casing for easy access.

Corrosion-proof, stainless steel construction of feederconditioner and spout. Revolving die cover and material-lifting flights assure long roll life . . . greater capacity.

Entire mill uses only 4 standard main bearings. Overall height, only 5 ft.

(A smaller sized model is also available.)

WRITE FOR DETAILS!

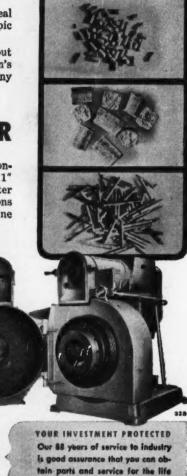


SPROUT-WALDRON

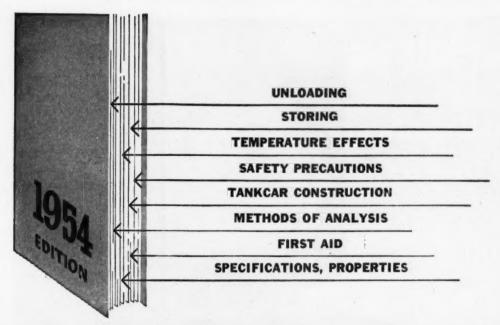
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of your Sprout-Waldran equipment.



CELANESE* FORMALIN MANUAL

Your non-technical personnel will find the Celanese Formalin Manual clear, concise, and easy-to-follow. Based on years of field experience with Formalin, this 1954 Edition has been brought completely up-to-date with the latest handling and storing procedures.

For technical personnel, it describes effects of temperature, basic reactions causing paraformation, and general information concerning construction materials for storage and handling equipment.

Users of Formalin will find this manual valuable in bridging the gap between engineers and non-technical operators. It is a must for plant safety training programs.

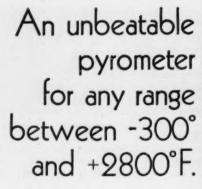
Use coupon below to reserve your copy now.

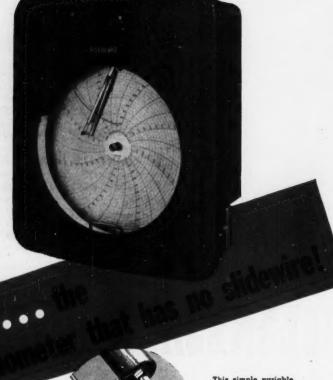
Celanese Corporation of America Chemical Division, Dept. 553-G 130 Madison Avenue, New York 16 Celanese — basic for Formaldehyde FORMALIN PARAFORMALDEHYDE FORMCEL* SOLUTIONS

TRIOXANE



INTERMEDIATES—SOLVENTS—PLASTICIZERS





. . no batteries to standardize!

DYNALOG

This simple variable capacitor is important to potentiometer users because it eliminates the conventional, troublesome slidewire altogether; and it gives Dynalog Instruments the continuous stepless balancing which assures higher accuracy, closer control.

*Reg. U.S. Pat. Off.

TOPS in simplicity . . . unequalled in its combination of accuracy, sensitivity, and speed of response . . . the Dynalog Potentiometer with standard thermocouples gives you unerring temperature measurement for any range up to 2800°F. Featuring sustained accuracy of ¼ of 1% of scale, it's an instrument of laboratory precision built to withstand the severest industrial conditions.

Unprecedented freedom from maintenance is the direct result of unique Dynalog design. There's no slidewire, no battery to standardize. There are no gears, belts, or high speed reversing motors. There's nothing to wear and cause dead space.

Single pen recording models provide full scale pen travel in 3 seconds standard, or as fast as 1 second without extra cost. The Multi-Record Dynalog provides color-coded records of up to 6 points at 6 second intervals. Both types give the convenience and low cost of circular charts.

Dynalog Potentiometers are also used for the measurement of pH, oxidation-reduction potential, and for other applications in which the process variable can be converted to a dc millivolt signal. They are available for pneumatic or electric control.

Write for your copy of Bulletin 427-1 which gives the whole story.

THE FOXBORO COMPANY, 915 NEPONSET AVE., FOXBORO, MASS., U.S.A.



FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

WHY IT PAYS TO BUY SHEETS and STRIP FROM US



• Let us "cut you in" on an opportunity for real steel buying profit. In many cases, it costs less to buy your steel sheets and strip already sheared to size. You'll do best, then, to buy at U.S. Steel Supply.

All our warehouses are equipped with the finest, most modern machinery for accurate shearing and cutting. This, combined with years of experience in "tailoring" steel to the customer's exact needs, adds up to closer shearing tolerances, less scrap

loss . . . more profit for you.

And there's never a question of quality with the sheets and strip you buy from U.S. Steel Supply . . . it's all good, dependable USS Steel. Our unusually wide selection of USS sheets and strip means you'll get immediate delivery of just the type, grade and size you want. Call us for: hot rolled, cold rolled, Vitrenamel, galvanized, galvannealed, paint bond, corrugated, long terne sheets, and hot rolled and cold rolled strip.

TRIPLE

What you want When you want it At the right price

U.S. STEEL SUPPLY

DIVISION

General Offices

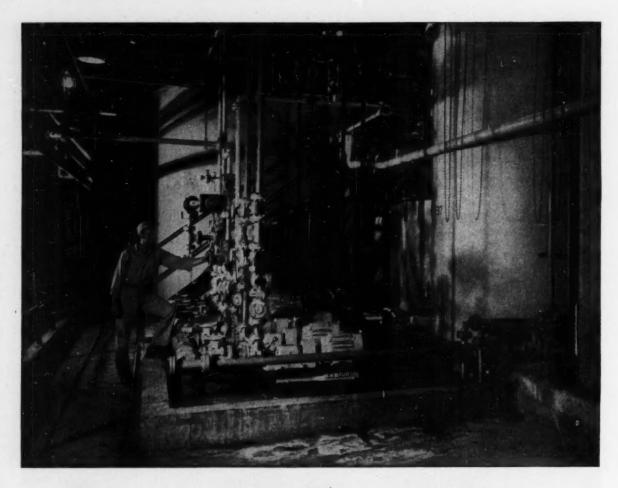
208 So. La Salle St., Chicago 4, Ill



Warehouses and Sales Offices

STEEL STEEL

UNITED STATES STEEL



They Go Together

Here's a battery of LaBour DZT and DPL pumps at the Michigan City, Ind. plant of American Cyanamid Company. This group included pumps for handling aluminum sulphate, sulphuric acid, and caustic soda, with valving to permit great flexibility of service.

This compact, well-organized installation is typical of the competent engineering so frequently associated with the use of LaBour pumps. Actually, of course, it's the other way round—LaBour

pumps are usually chosen by the competent engineers who take pride in creating installations to operate profitably.

Men who are unwilling to compromise with the future—who stake their professional reputations on year-after-year performance of their handiwork—generally insist on LaBour pumps for the installations they design. The resulting cost figures, compiled for overall service, prove their wisdom.

ORIGINAL MANUFACTURERS OF THE SELF-PRIMING CENTRIFUGAL PUMP

LABOUR

THE LABOUR COMPANY, INC. * Elkhart, Indiana, U.S.A.



B&G HEAT EXCHANGERS ... FOR EVERY TYPE OF SERVICE!

TYPE "OC" STRAIGHT TUBES

Sound design, plus precision manufacture, assure efficient operation. Removable tube bundle easily cleaned inside and out. Minimum free annular area and baffles with close tolerances reduce bypassing around the tube bundle. Other features include high tensile strength bolting, full thickness tube sheet and ample metal ligaments between tube holes. ASME quality at no extra cost.

TYPE "U" U-BEND TUBES

Recommended where the lower price of a single tube sheet unit is a necessary economy. These exchangers are also desirable where temperature differential across the tube bundle is extreme. Features include external gaskets, full tube bundle and close tolerance baffles for minimum by-passing. Metal ligaments between tube holes are extra large for internal strength. High tensile strength bolting. ASME quality fabrication.

FUEL OIL PRE-HEATERS

Reduce viscosity of heavy oils to permit pumping—control temperatures for proper atomizing of different oils. Units are available in straight tube and U-bend construction, for steam or water as the heating medium and with 2 to 10 passes.

GAS COOLERS

Efficient "air tube" design (air in tubes, water in shell) makes more effective use of cooling surfaces and reduces pressure drop. Cooling water is directed back and forth across tubes by baffles and moves in a direction counter to air flow.

TYPE "WU" WATER HEATERS

Produce large volumes of hot water from amazingly small units. Boiler water is pumped by a B & G Booster through the shell, greatly increasing the capacity of the heater. This also permits close control of service water temperature. Because of pumped circulation, connecting pipes and fittings are reduced in size, saving material and labor. "WU" Heater is instantaneous—no tank needed.





BELL & GOSSETT

Dept. DM-14, Morton Grove, Illinois

Canadian Licensse: S. A. Armstrong, Ltd., 1400 O'Conner Drive, Toronto, Canada

Powell KONCENTRIK-FITTED Valves

A Powell exclusive that eliminates welding, soldering, screwing, or bolting of valves and tubing.

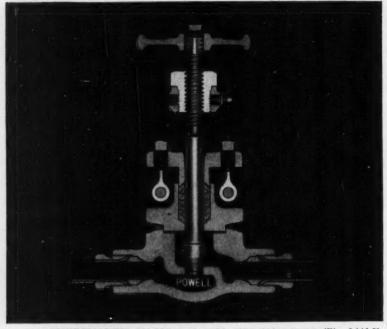
Powell Koncentrik-Fitted Valves provide a positive leakproof connection of valve and tubing. The ends of the valves are lengthened and threaded on the inside to accommodate the patented Koncentrik Full Floating Seat and Tube Nut, as well as the tubing. The tighter the Tube Nut is pulled up, the tighter the seal.

Powell Koncentrik-Fitted Valves are especially adapted for instrument lines and for installations requiring thin wall tubing such as Schedule No. 5 or 10.

Available through distributors in principal cities in Stainless Steel alloys (304, 316 and 20), Monel Metal, Nickel and Aluminum; and in a wide variety of types—Globe, Gate, Check, Needle and "Y" Valves. On problems or for descriptive illustrated circular, write direct to The Wm. Powell Company, Cincinnati 22, Ohio.



KONCENTRIK-FITTED 200-POUND STAINLESS STEEL GATE VALVE (Fig. 1832-K). Screw-in bonnet, inside screw rising stem. Solid wedges regularly furnished; split wedges on special order. For corrosion-resistant tubing up to 1" O.D.



KONCENTRIK-FITTED 300-POUND STAINLESS STEEL GLOBE VALVE (Fig. 2446-K-Sectional). Bolted bonnet; outside screw stem and yoke. Stem rises through bushing in upper yoke.

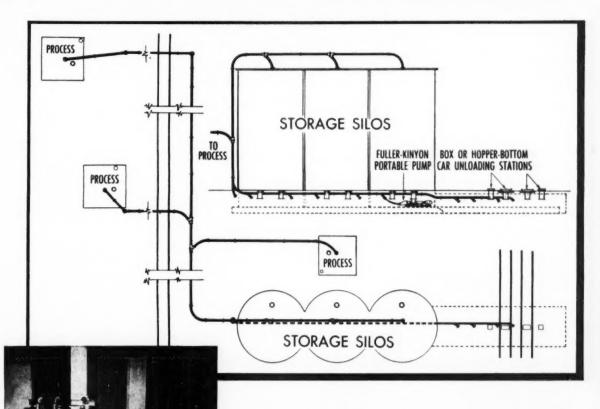


KONCENTRIK-FITTED 300-POUND STAINLESS STEEL SWING CHECK VALVE (Fig. 2345-K). Bolted cap. Metal or Teflon (on order) discs are hung on a 5° angle. For corrosion-resistant tubing up to 1" O.D.

*Trade Mark Reg. U.S. Pat. Off.

CONTROLS FOR THE LIFE LINES OF INDUSTRY

Powell Valves 108th year



speed and economy assured with Fuller-Kinyon

Deep in the heart of Texas, this Fuller-Kinyon Conveying System is at work handling bulk shipments of pulverized phosphate rock from cars to storage, for a prominent chemical company.

This same portable Fuller-Kinyon Pump, in addition to unloading from box or hopper-bottom cars, on adjacent tracks, and delivering to any one of three storage silos, can be moved on a track to positions underneath these silos. Connection is easily and quickly made to the silo to be emptied and material conveyed to any one of three widely separated process points in the plant.

Advance designing makes this dual use of the Fuller-Kinyon Pump feasible.

Conveying is done at the rate of 50 tons an hour, with the longest conveying distance approximately 690 feet; together with branch lines making a total of about 1070 feet.

A Fuller Rotary Single-stage Compressor furnishes the necessary air to the Fuller-Kinyon Pump for conveying.

If you handle bulk shipments of dry, pulverized materials it will be worth your while to learn about Fuller air conveying systems now. Write today!



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P-147

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To Meet All Your Fittings Needs
With an Unsurpassed Range
of Sizes and Materials



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For dependable service that results from an ideal combination of broad line and ample stock... specify and buy LADISH... the Controlled Quality line that offers a complete range of sizes, types, weights, pressure ratings and materials needed for virtually any piping installation. Your local Ladish distributor's ample stock is backed by complete factory inventories to keep your piping jobs on schedule. So, for complete service in fittings... specify and buy LADISH.

LADISH

For your new 304-page Ladish Fittings Catalog, No. 55
contact your Authorized Ladish Distributor,
your local Ladish District Office, or write
to Ladish Co., Dept. CE, Cudahy, Wis.

THE COMPLETE Controlled Quality FITTINGS LINE PRODUCED TO ONE STANDARD OF UNSURPASSED QUALITY

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craftsmanship

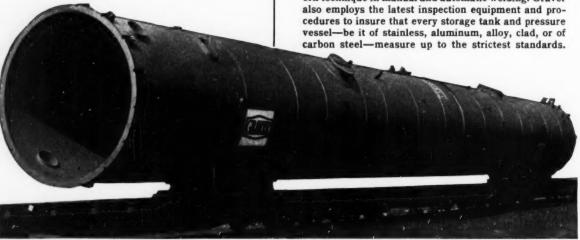
means:



Applied Research! These Graver engineers are running distortion tests in the welding laboratory. Our research in welding techniques has resulted in numerous advances in the industry, including another Graver "first," the automatic vertical-seam field welder.



Expert Welding! This skilled Graver craftsman is busy welding special alloy strips to the inside of a large saturation absorber. Graver utilizes every modern technique in manual and automatic welding. Graver





Specialists in the fabrication of towers, tanks, pressure vessels

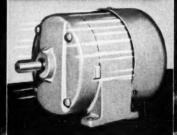
The Finished Product! This huge 106-ton fractionator tower measures 11' 6" I.D. by 120' 2" in height. It evidences the painstaking research, experienced ability, and thorough inspections that are part of every Graver product.

GRAVER TANK & MFG. CO., INC.

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TRI SE CLAD THE LEADER IN MODERN MOTOR DESIGNATION





A BLANKET OF AIR spreads over entire surface, cooling and cleaning the new Tri/Clad '55'

CORROSION-RESISTANT FAN



TEXTOLITE* FAN resists acids, alkalis . . . is one of chemistry's vital contributions to the motor.

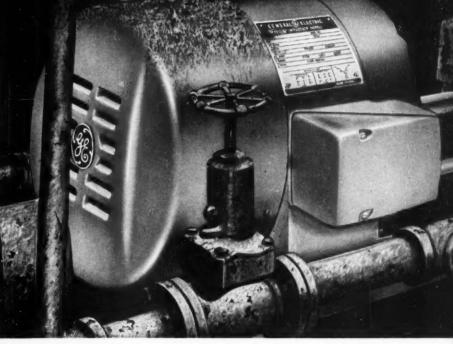




SEALING COMPOUND applied on rabbet fits helps to seal out corrosives, moisture and dirt.



RUBBER GASKET waterproofs lead entry to stator of motor. Conduit box is also gasketed.



Now, the new chemical motor . . .

G-ETRI 55 CLAD enclosed motor

resists corrosion and moisture!

General Electric's all-new Tri/Clad '55' enclosed motor meets the tough requirements of the chemical industry. Truly a chemical motor, the Tri/Clad '55' takes advantage of the industry's latest materials including silicone, polyester film, Textolite* and neoprene.

Because it's better protected, this standard motor gives you longer motor life in tough jobs. Frame and end shields are rust-resistant cast iron. Carefully machined rabbet fits are tightly sealed. Rubber gasket protects lead entry to stator.

New insulation materials also add life to this motor. A silicone Dri-film* coating on the stator sheds water-reduces insulation failure due to moisture. New polyester-film for slot and phase insulation is eight

General Electric Tri/Clad '55' motors are available now in many ratings. The entire line, 1 to 30 hp a-c motors, available soon. For full details contact your nearby G-E Apparatus Sales Office or G-E Motor Supplier today. For bulletins on the complete line, write General Electric Company, Section 648-8, Schenectady 5, New York.

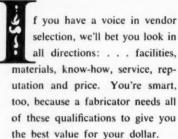
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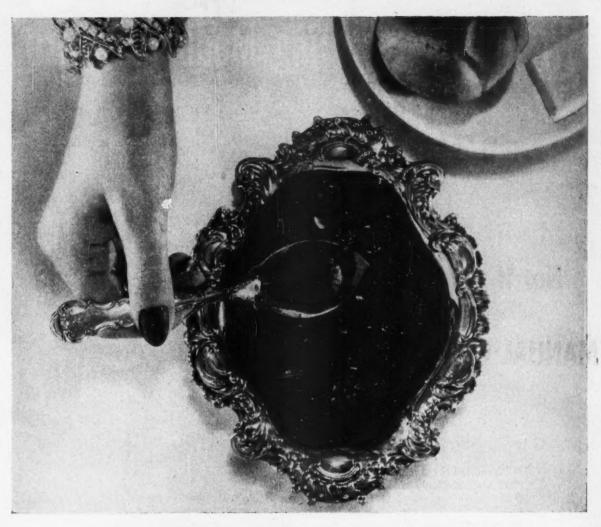


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Because pectin is highly sensitive to heat which decreases gel strength and damages flavor, accurate time and temperature control is essential in the concentration of the pectin liquors. Swenzon engineers, using the Swenson Long Tube Vertical Evaporator, devel-

oped a single pass cycle for each evaporator effect... reducing heat exposure time to a minimum, permitting the use of rapid, high temperature evaporation with complete safety. The result was *improved* lower cost pectin.

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> If the diaphragm control valves in your plant were suddenly rendered inoperative by failure of the operating medium, (or in rare instances by diaphragm failure within the valve), would you be forced to shut down immediately while repairs were made? Not if your valves are equipped with the BS&B Type Y Continuously Connected Side Handwheel for emergency manual control!

The Type Y is especially designed for use with all BS&B Diaphragm Control Valves, including Types 15 and 86, and the pressure balanced Type 73, where no by-pass is provided around the valve. It has a cast iron frame which fits onto the various Climax Valve Yokes. Working parts are of stainless steel, and it is equipped with an Ampcoloy jack screw, "Oilite" bearings and a large handwheel for ease of operation.

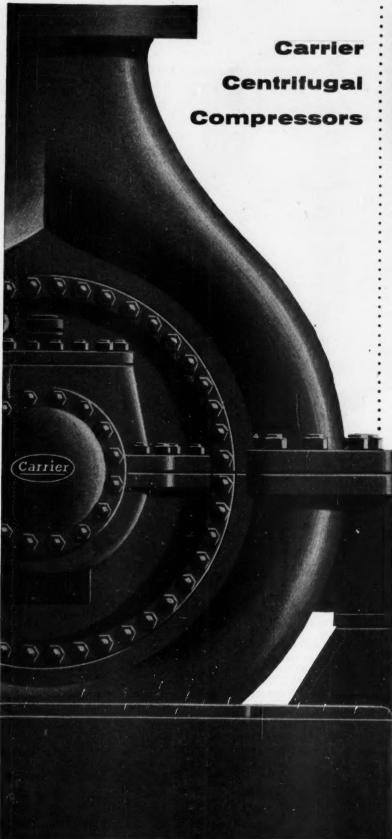
With the Type Y, control valves can be manually positioned in either direction independently of the normal controlling impulses. Its mechanism provides stops so that travel can be set to cover any portion of the complete valve stroke.

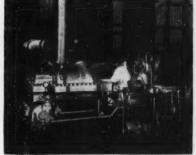
Avoid costly shut-downs due to operating medium or diaphragm failure! You can keep your plant operating indefinitely on an emergency basis if your control valves are equipped with the BS&B Type Y Continuously Connected Side Handwheei!

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on the job at

Wyandotte Chemicals Corporation

This Carrier Centrifugal Compressor is on the job in Wyandotte's plant at Wyandotte, Michigan. It's part of the process air equipment and is designed to handle 4500 c/m of air up to a discharge pressure of 30 pounds gauge. The unit operates at 10,200 rpm.

Carrier makes a complete line of centrifugals for gas compression and refrigeration—up to 10,000 hp in a single unit. There are hundreds of these dependable, efficient Carrier machines on the job at dozens of chemical plants and refineries across the country—Reichhold Chemicals Company, Cities Service Company, The Texas Company. May we assist you?

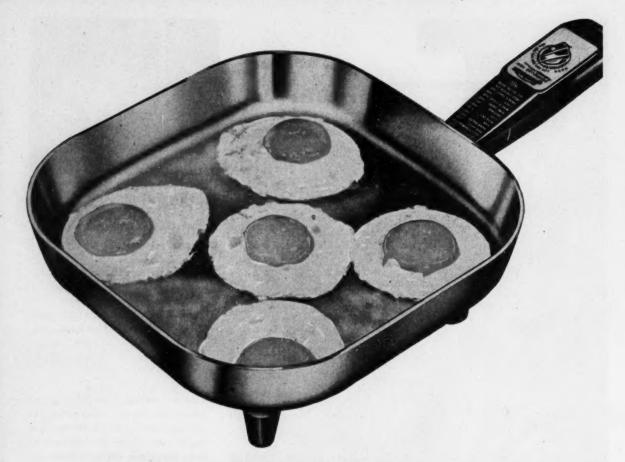
If you'd like a copy of our informative booklet,

"Centrifugal Compressors for Industry,"

please call your nearest Carrier office. Or write direct to Carrier Corporation, Syracuse, New York.



contribugal compressors refrigerating equipment





TRENTWELD stainless tubing in handle of Sunbeam frypan

TRENTWELD stainless tubing chosen for connecting unit of new Junbeam automatic frypan

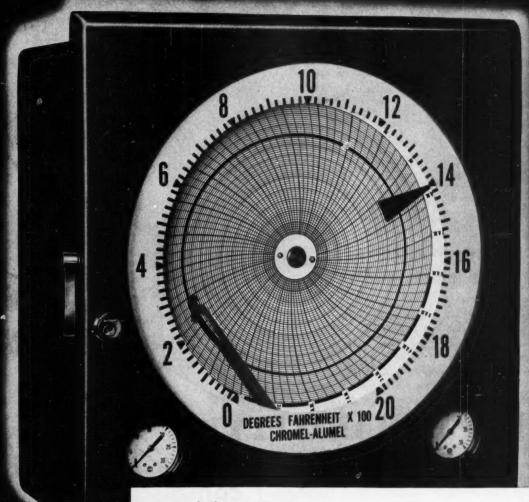
Two six-inch lengths of TRENTWELD stainless tubing form an important element of this popular new automatic frypan. One tube carries the electrical connection to the heating element embedded in the pan, and the other carries the dial connections to the thermostatic control. They make a tight, waterproof seal . . . and add strength to the bakelite handle.

You'll find more and more manufacturers specifying TRENTWELD for products ranging from frypans to heat exchangers. That's because you just can't buy better tubing than TRENTWELD, no matter what the application. TRENTWELD stainless and high-alloy tubing is a product of tube mill specialists.

And when it comes to sizes and finishes, Trent provides the widest range in the industry . . . standard sizes from 1/8" to 40" O.D. - larger sizes on special order. Next time you need tubing be sure and make it TRENTWELD.



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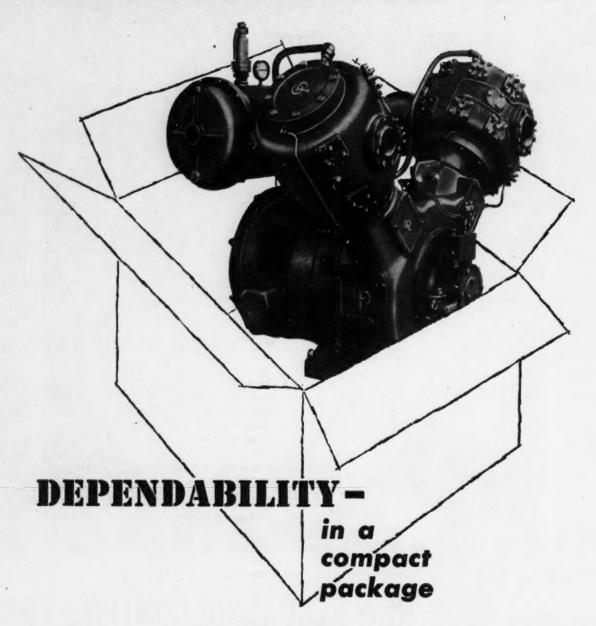
THE "MAGNETIC STANDARD" provides truly continuous standardization, as there

is no lapse of control during standardization periods. This is especially important where a momentary loss of control has adverse effects on the quality of your product.

FOR FURTHER INFORMATION contact your nearest G-E Apparatus Sales Office or write for bulletin GED-2100, Section 602-284, General Electric Company, Schenectady 5, New York.

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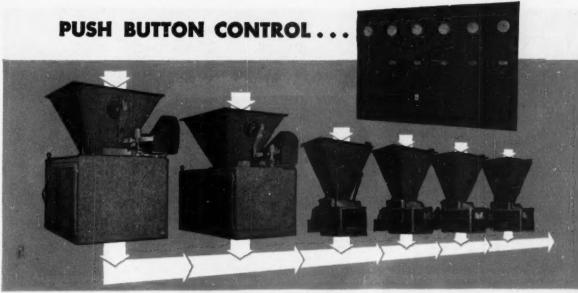


With floor space at a premium, CP's space-saving Type Y Compressor is the answer! Shipped as a package ready for easy installation on a simple, inexpensive foundation, the dependable Type Y is designed for continuous operation and long life with high efficiency. Location of air inlet and discharge openings on cylinders permits the simplest and most compact piping arrangement. The "Y" arrangement also provides maximum accessibility to cylinders and to the easy-to-clean, easy-to-maintain shell-and-tube intercooler.

The Type Y has roller main bearings, precision connecting rod bearings, and multi-step capacity regulation. Available from 75 to 250 hp; 410 to 1663 c.f.m. capacity, and in single or multi-stage designs for a wide range of pressures. Chicago Pneumatic Tool Co., 8 East 44th St., N. Y. 17, N. Y.

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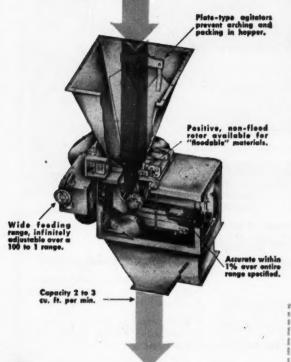


for Southern compounding of dry materials

This six-feeder production line, built for one of the country's leading processors of fertilizers, is designed for complete push button control from a central control panel. The OMEGA BELT GRAVIMETRIC FEEDERS (Models 44-20A and 50-8) used in this system continuously weigh and feed superphosphate, potash, and other chemicals at a high production rate. Each feeder is totally enclosed, dust-tight, and built for continuous, accurate operation.

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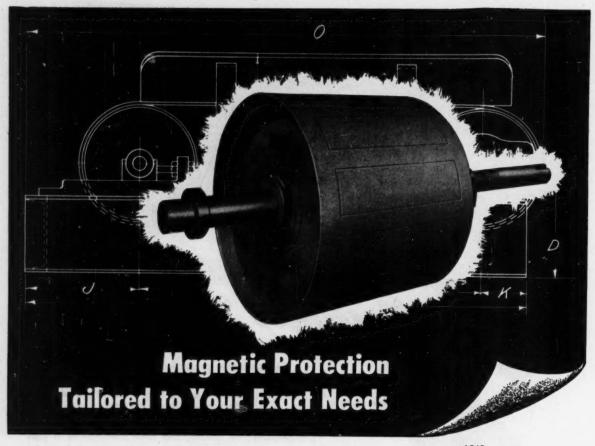
Find out for yourself how OMEGA continuous process equipment will boost your production and your business....



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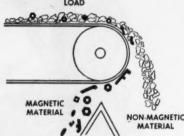
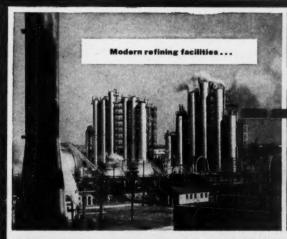


Diagram showing how Stearns magnetic pulley removes tramp iron.

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generator, and on lines serving strip heaters in power house.

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One job Everdur* Electrical Conduit does on the Duluth-Superior Bridge is protect electric light lines. Heavy rain and snow driven by 60 to 70 mile-an-hour winds often pound at this conduit. Heat and cold do their worst. It is exposed to acid fumes from ore boats and rail traffic. Vibration from opening and closing of the bridge, and constant traffic, is a daily threat. Yet recent inspection shows the Everdur Rigid Conduit

still in excellent condition. Not a sign of wear, rust or corrosion!

Everdur Electrical Conduit is made of Everdur Copper-Silicon Alloy in two wall thicknesses (R.C. and E.M.T.). For additional information about this Anaconda Product, write to: The American Brass Company, Waterbury 20, Conn. In Canada: Anaçonda American Brass Ltd., New Toronto, Ont.

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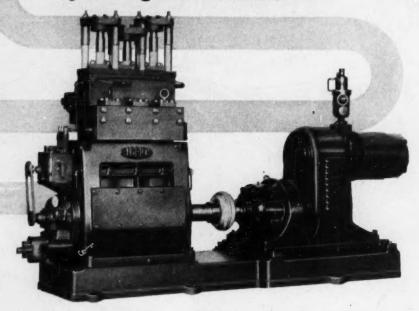
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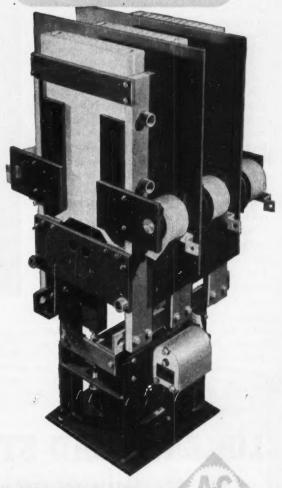
Durability and long-term dependability were given prime consideration in the design of the Allis-Chalmers Type 256 air-break contactor. As a result, the roughest repetitive duty becomes routine - contact operations are actually numbered in the millions with a minimum of servicing.

DESIGN FEATURES

By utilizing a simple vertical motion and double break contacts, troublesome maintenance factors, such as mechanical linkages, turning shafts, shaft bearings and flexible leads, have been eliminated. From the operation standpoint, two gaps in series cut arc voltage in half. Rapid arc extinction is further facilitated by magnetic blowouts at each gap, operating with arc chutes designed to take full advantage of dual blowouts.



In Allis-Chalmers Type H high voltage starters, Type 256 air-break contactors - along with meters, overload relays, current limiting fuses, auxiliary switches - are coordinated to meet heavy duty demands - to provide high capacity interruption and complete protection for man, motor and machine. For complete information see your nearby A-C representative, or write Allis-Chalmers, Milwaukee 1, Wisconsin, Ask for bulletins 14B6410B and 14B7303.



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CLAD STEEL WEIGH TANKS GUARD PLASTIC PROCESSING

Provision of economical, efficient, automatic weighing for chlorinated hydrocarbons presented a problem for this plastic processor. Discoloration and other contamination of the sensitive chemicals had to be avoided, and subzero temperatures were necessary to maintain their stability. So the company's engineers designed jacketed weigh tanks on suspended scales, allowing for circulation of coolant between the shells. Nickel-clad steel was specified as the most economical means of providing all the desired benefits in the inner shell.

The 20% layer of nickel cladding—permanently and integrally bonded to low-cost carbon steel backing plate—assures the corrosion resistance of solid alloy. There can be no discoloration of the sensitive plastic because of metallic pick-up, and smooth, inside clad surfaces are easily cleaned. Maintenance costs have been low since this equipment was placed in operation in 1947. Nickel-clad steel also gives the fast, uniform heat transfer so critical to the process. Rounded tops and all-welded construction provide strength; the ½"-thick clad steel walls do not warp or distort under pressure.

Whatever demands your processing places on tanks and pressure vessels, a wide range of clad steels will give you these benefits economically. You can profit by asking your fabricators' assistance early in your planning. Working with your engineers and consultants, a qualified equipment builder can help tailor clad steel tanks and vessels to your exact needs. They minimize first cost and assure long, trouble-free service life.



Corrosion-resistant nickel-clad steel in this battery of jacketed weigh tanks prevents contamination of vinyl plastics during processing.

Ask one of your fabricators to show you the new Lukens clad steel movie, "Equip for New Profits." Here—in full color and sound—are factual accounts of how clad steel equipment brings new economies. The story can suggest new ideas to everyone concerned with production efficiency. Or, contact Manager, Marketing Sprvice, Lukens Steel Company, 678 Lukens Building, Coatesville, Pa.



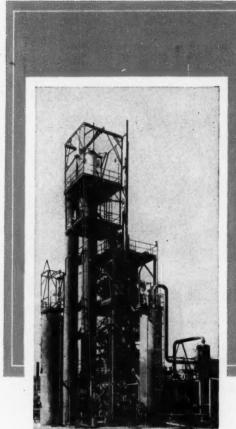
LUKENS CLAD STEELS

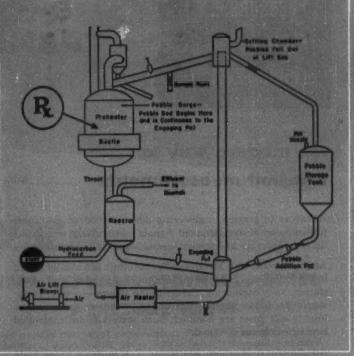
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Pebble Heater in which ALUNDUM heat exchange pebbles have proved ideal as a heat transfer medium. Flow diagram shows how the continuous pebble bed moves from the engaging pot through reactor, preheater and chambers at a rate governed by a control device in the engaging pot. Heat is supplied by hot gases generated in the bustle-type combustion chamber. (Diagram courtesy of Petroleum Refiner.)

Pebble heaters with ALUNDUM* pebbles

Pebble heaters are now available which are capable of heating gases above operating temperatures permissible in conventional tube furnaces. Low initial cost, high operating efficiency and the use of low cost gas or oil fuel are attracting favorable attention to these heaters for high temperature processing.

For the production of ethylene, for example, the Phillips Petroleum Company has installed a 30 Mm Btu per hour commercial pebble heater at Borger, Texas, following several years of successful pilot plant operation.

ful pilot plant operation.

In this installation, Norton ALUNDUM heat exchange pebbles have given excellent results. ALUNDUM pebbles, engineered to stand up under abrasion, impact

and repeated heating and cooling, are prescribed as the ideal heat transfer medium for pebble heaters. Also, their high refractoriness, which prevents softening or incipient fusion at any point in the pebble heater's upper bed, keeps them from "bridging" together and causing stoppages in the moving bed.

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are included in the broad Norton line of engineered and prescribed refractories. For information concerning ALUNDUM heat exchange pebbles or other Norton refractories, or for expert technical aid, call in your Norton Refractories Engineer. Or write to NORTON COMPANY, Refractories Division, 506 New Bond

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American-Microsen Electronic Transmitters are ruggedly built for reliable performance under the most severe operating conditions. Get complete information. Write for Catalog 400A.



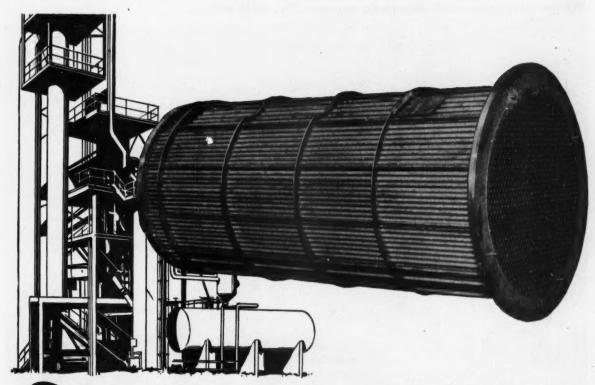




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Back of Struthers Wells' choice lie good reasons: Republic is the world's largest producer of stainless and alloy steels. Republic pioneered the widespread use of stainless, as well as the manufacture of stainless steel tubing. And in shell and tube equipment, Republic's more than a quarter century of experience translates itself into longer life between retubings.

Installation costs are lower, too. ELECTRUNITE Heat Exchanger Tubes are uniform. That means uniform wall thickness, without longitudinal thin spots. Uniform diameter, which means tubes slide easily and quickly through holes in drums or headers. And since tubes expand evenly, there's less danger of over- or under-rolling.

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What to do about corrosion when you process hot chlorine or hydrogen chloride at 500° to 1000° F.

Here's what research by a large chemical company has revealed about corrosion of alloys in dry chlorine and hydrogen chloride as temperatures go up.

The corrosion rate rises but slowly...up to a certain critical point. Then gallops.

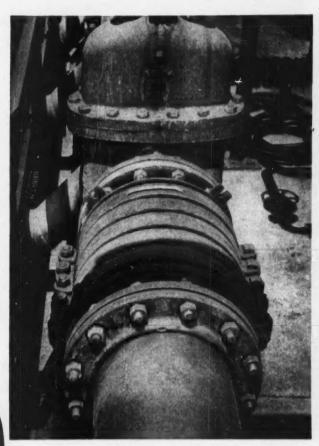
The point where severe corrosion begins varies with the alloy . . . depends largely on the temperature at which protective metal chlorides break down.

Iron, steel, and aluminum, for example, were all found to ignite below 500°F. in dry chlorine. Copper around 600°F. Not so with Nickel and Inconel. They were found useful up to about 1000°F. in dry chlorine. The most useful of all alloys tested, in fact.

In dry hydrogen chloride, Nickel does well up to 950°F.... Inconel up to 900°F.



Hydrogen is burned with chlorine in these towers to produce hydrogen chloride. Nickel sleeves protect reactant feed lines. In the same plant, Nickel domes collect chlorine over electrolytic cells at temperatures in excess of 1000°F.



Hot chlorine and hydrogen chloride line in a carbon tetrachloride plant, showing an Inconel expansion joint and Inconel flange bolts. Elsewhere, this plant uses 3" Inconel furnace pipes to heat process gases for chlorinating hydrocarbons.

Experience in many installations bears out that Nickel, Inconel and other high nickel alloys protect equipment and product against the action of these gases at high temperatures. Two installations are illustrated.

So if you have a hot chlorine or hydrogen chloride corrosion problem . . . make sure you have the facts. Write for free copies of "Corrosion by Chlorine and by Hydrogen Chloride at High Temperatures" and Inco's Technical Bulletin T-29. And be sure to contact Inco's Corrosion Engineering Section.

THE INTERNATIONAL NICKEL COMPANY, INC. 67 Wall Street New York 5, N.Y.



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FABRICS ENGINEERED TO FIT YOUR NEEDS — Need adaptation of an existing fabric to your special purposes? Or creation of an entirely NEW fabric — cotton, synthetic or blend — to meet your specifications? Mt. Vernon-Woodberry's staff of textile engineers is available on request to help you with your problems in development or application of industrial fabrics.

Mt. Vernon-Woodberry Mills



Main Office: 40 Worth St. New York

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One of a series of comprehensive laboratory controls throughout production to assure uniformity in all Mt. Vernon-Woodberry products. Here fabric thickness after weaving is being gauged.







this combination will help you Relax!

There will be a fly on the rod—not in the ointment, when you turn those stainless steel casting, valve and fitting problems over to us. Thirty years of high alloy experience, and complete facilities for design, production and research is a combination that guarantees quality and service.

When you hook up with Cooper Alloy you've cast your line for some real peace of mind. Our stainless steel products are tops in quality—use them with confidence, and relax.











fitting ,

valve

Quikupl

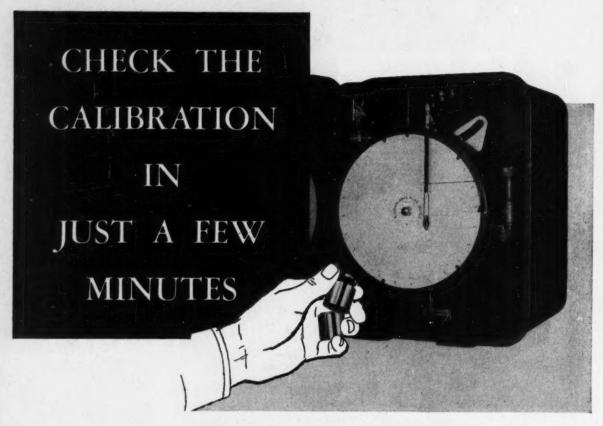
impeller



COOPER ALLOY

THE COOPER ALLOY FOUNDRY CO. . HILLSIDE, N. J.

the Landing moderate of STAINIESS STEEL values. Estings and continue



A routine check of the calibration of any Hagan Ring Balance Meter takes just a few minutes. One man can make the check, and he only needs the calibrated dead weights furnished with the meter.

The check can be made with the measuring element under full static pressure, and without requiring a manometer or other cumbersome testing equipment.

The procedure is simple. Equalize the meter, hang calibrated weights on the ring element, and compare the pen arm position with the total dead weight used.

The ease and simplicity of the dead weight method makes meter checking an easy operation, instead of a real chore.

The Hagan Ring Balance Meter design includes many other advantages, such as these:

- No stuffing boxes or pressure-tight bearings to leak or to add friction.
- Mercury level is not critical.
- Full scale differential with any ring is adjustable over 7:1 range.
- Sensing elements are interchangeable for full scale differentials from 1" to 420"
- Pneumatic or electric signal transmitters are available for remote recording or for automatic control purposes.
- Simple automatic compensation for such factors as fluid density, pressure or temperature is a standard attachment.
- Two rings, measuring separate quantities, can be mounted in a single meter housing. Individual measurements can be recorded separately, as well as added or subtracted.

We will be glad to suggest the metering equipment best suited for improving an existing installation, or for extensions and new construction.

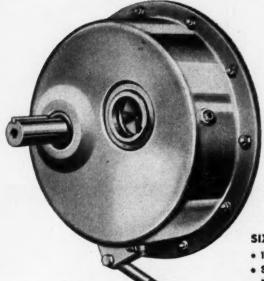


Hagan Corporation

HAGAN BUILDING, PITTSBURGH 30, PA.

Boiler Combustion Control Systems • Ring Balance Flow and Pressure Instruments • Metallurgical Furnace Control Systems Control Systems for Automotive and Aeronautical Testing Facilities

Falk STEEL Shaft Mounted Drives









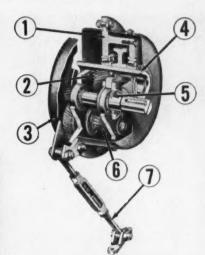


APPLICATIONS UNLIMITED

The range of applications to which the all-steel Falk Shaft Mounted Drive is ideally suited is so wide that complete listing is impracticable. The sketches above are included only to indicate a few typical installations where considerable speed reduction in limited space is an important advantage.

SIX SIZES

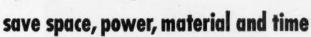
- 1/2 to 30 hp
- · Single or double
- Wide output spee range-420 to 10 rpm



FALK "In-Built" Factors... that give maximum efficiency, convenience and dependability

- 1 All-steel Frame, with more than double the rigidity of iron, supports all rotating elements.
- 2 Precision Helical Gears, designed and machined by Falk, rated to AGMA standards.
- 3 Pressed Steel Housings, whose sole function is to keep oil in, dirt out; easily removed for gear inspection without dismounting unit.
- 4 Through Hollow Shaft with counter bore provides for easiest installation or removal from driven machine shaft extensions.
- 5 Backstop can be furnished with the unit or added later for positive prevention of reverse rotation.
- 6 Positive Lubrication, continuous direct dip of revolving elements at all speeds.
- 7 Tie Rod and turnbuckle serve as anchor and facilitate V-belt or chain adjustment,

These versatile, NEW speed-reducing units



Here is the economical solution to the countless application problems requiring efficient speed reduction in limited space! The new Falk all-steel Shaft Mounted Drive-a modification of the universallyaccepted Falk Motoreducer design-embodies many exclusive structural and functional features which add up to better service, longer life and substantial savings.

This rugged, compact drive mounts directly on the driven shaft-a distinct saving in floor space. Its precision Falk helical gearing gives highest mechanical efficiency, with a resultant power saving. No adjustable motor bases or slide rails are required. Installation is simple and rapid-output speeds can be quickly changed; thus time is saved...Write to Department 247 for engineering bulletin, including selection and dimension details.

THE FALK CORPORATION, Milwaukee 8, Wisconsin MANUFACTURERS OF

- Motoreducers
- Speed Reducers
 Flexible Couplings
- High Speed Drives

- Marine Drives · Steel Castings

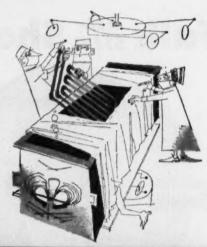
... a good name in industry

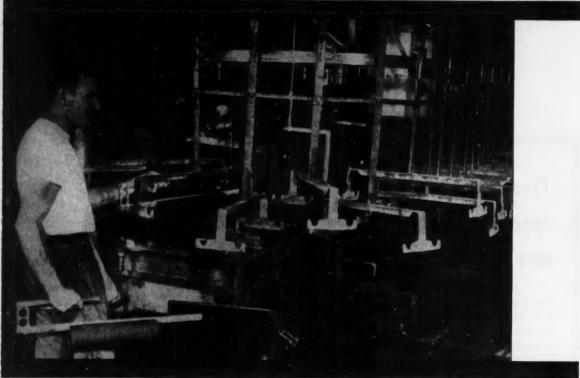
coil-itis* cured — chipping eliminated by **PLATECOILS**

to save 6 to 8 hours daily

Use of Stainless Steel Platecoils in a phosphate coating tank at Sealed Power Corporation has completely eliminated a 6 to 8 hour a day chipping job. The brass pipe coils formerly used became so coated with scale they had to be cleaned daily.

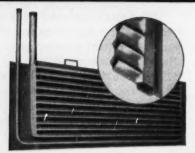
Three Platecoils heat this tank as efficiently as four pipe coils and maintain desired temperatures throughout both shifts. Scale removal, when necessary, takes less than two manhours compared to 10 hours for pipe coils.





PLATECOILS replace pipe coils for 50% of the cost

Coil-itis is the constant doctoring of wet processing tanks for pipe coil troubles. It can be cured easily by replacing pipe coils with Platecoils. Immediately, you will notice the difference at Platecoils put new life and profits into your heat transfer processes. They heat or cool 50% faster and take 50% less space in the tank. They save as much as 50% in initial cost and 50% in maintenance costs in addition to overcoming the limitations and operating difficulties of old fashioned and outmoded pipe coils.



Bulletin P61 shows how Platecoils are replacing hipe coils at a savings throughout industry. Send today for your copy.



Platecoil Division, TRANTER MANUFACTURING, inc., Lansing 4, Michigan



its performance that we installed Speed-Trols on ALL of our vegetable oil mixers...Speed-Trols give the exact speed regulation needed for vegetable oil processing."

Industry Names Speed-Trol Production Advantages

In a nation-wide user survey of Sterling Speed-Trol Variable Speed Electric Power Drives:

86% Increased Production. 48% Improved Product Quality. 64% Reduced Production Costs. 42% Modernized Equipment and Machines. 20% Reduced Spoilage and Rejects. 28% Increased Machine Versatility. 18% Increased Plant Safety. 34% Improved Employee Morale. 62% Lowered Maintenance Costs.

46% Saved Space. 18% Simplified Operations. 16% Synchronized Operations.

Investigate the possibilities of bringing some of these Speed-Trol production advantages to your plant. Sterling Engineering Sales Offices and over 400 Distributors and Service Shops throughout the nation effectively serve every industrial, commercial and agricultural area.



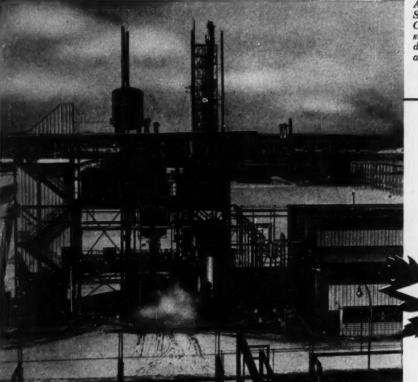
20-PAGE ILLUSTRATED CATALOG ... Sterling Speed-Trol, Slo-

Speed, Klosd and Klosd-Tite Electric Power Drives. Write for catalog No. G-413

There is a Sterling Electric Power Drive to Meet Virtually Every Requirement

Sterling Slo-Speed Electric Power Drives-for geared low speed at its best Sterling Klosd and Klosd-Tite Motors-for constant normal speed at its best

Plants: New York City 51 . Chicago 35 . Los Angeles 22 . Hamilton, Canada . Santiago, Chile Offices and distributors in all principal cities



An important new component in the Sarnia Plant of Dow Chemical of Canada, Limited – a latex plant constructed by Bechtel – went into production last December, 6 weeks ahead of schedule.

CANADA



Bechtel is assisting in Canada's remarkable industrial growth, particularly in the fields of chemicals and petroleum, through services of ...analysis, design, engineering, procurement and construction.



BECHTEL CORPORATION

BUILDERS FOR INDUSTRY
Los Angeles • SAN FRANCISCO • New York

TRAMP IRON PULLED FROM LIQUID-CARRYING PIPES by ERIEZ Permanent Magnetic Traps

Product Contamination, Machinery Damage and Production Tie-Ups Due to Loose Iron Stopped Automatically by Eriez Installations!

The Eriez Permanent Non-Electric Magnetic Trap, one of many types of Eriez installations, was designed for economical, efficient protection against the passage of tramp iron through pipelines carrying liquids and semi-liquids. The powerful magnetic alloy, Alnico V, makes the trap suitable even for pressurized lines.

Fine ferrous objects and large iron scraps are pulled from the liquids and held by the Eriez permanent magnets, protecting the product from contamination, protecting pumps, screens, grinders, fillers, etc., from damage and protecting management against man-hour losses and production losses.

The Eriez Pipeline Trap consists of a noncorroding metal housing and a specifically engineered magnet which is not affected by temperature. Cleaning is simply accomplished by easily removing the face plate. This is the only maintenance. The Alnico V castings keep their power for a lifetime. There are no wires. No upkeep. The first cost is the last cost! The Eriez Trap is available with iron pipe threads or Sanitary threads in 2", 2½", 3", and 4" pipeline sizes.





Chocolate Protected Against Fine Metal At Hooton

Hooton Chocolate Company, well known chocolate manufacturer of Newark, N. J. provides positive and automatic quality control in a line carrying liquid chocolate by installing an Eriez Magnetic Trap. The installation is able to remove ferrous particles so small that they could pass through a 300

mesh screen! This simple, inexpensive assurance against product contamination by iron of any size is an example being repeated by food and chemical processors across the country. Not only product contamination but machinery damage and shut-downs caused by larger pieces of tramp iron are also avoided.

NOW! FROM ERIEZ, PIONEERS OF MAGNETIC EQUIPMENT...THE "MAGNALARM", A MAGNETIC SEPARATOR WITH A BRAIN!

Here is what the industry has been waiting for! The "Magnalarm", just developed by Eriez, is a permanent magnetic separator with a built-in "brain" that signals you automatically when a predetermined amount of tramp iron is caught by the separator. The alarm signal can consist of a light going on ... or a bell ringing ... or can shut down your machinery! Here is the maximum insurance against the danger presented when the separator is neglected by maintenance men ... or is in a difficult position ... or catches an unforeseen amount of tramp iron. The problem posed by the fact that any magnet temporarily losse part of its "pull" when covered with tramp iron is now solved. The "Magnalarm", with its ferrometer brain, tells you when your magnet reaches the minimum efficiency. You rest secure in the knowledge that your magnetic separator is always on guard ... protecting you from an overflow of tramp iron that can result in expensive fires, machinery damage and product contamination. The cost? Only a little more than a regular magnetic separator. Simple to install. Write for the free bulletis, You'll agree on reading all the details that the "Magnalarm" is the most revolutionary forward step in magnets since Eriez introduced the non-electric permanent-type magnet!

ERIEZ

Super Sweeper keeps plant aisles, lots, etc. free from nails, scraps

Eriez Permanent Magnetic Super Sweeper removes dangerous tramp iron from floors, parking lots, warehouses, etc. Four sizes in three magnetic strengths. Manual or mechanical operation... and you can pull it, push it or suspend it. Write for free bulletin on this versatile trouble saver.

Want more information? Free bulletins are yours for the asking... Send along the handy inquiry coupon below for complete information.

	Please send me the following bulleting:
	Eriez Non-Electric Magnetic Pipeline Trap
	Eriez Magnetic Separators for the Food Industry
Language appropriate	General Catalogue
manufacture and and	Super Sweeper Bulletin
	Magnalarm Bulletin
Name	
Address	
Company	Title

since 1938

Glycerine esterifies

Maleic Resin

In making specialty resins such as modified maleics and phenolics, and in making a wide range of standard resin types, America's leading resin manufacturers find Glycerine has many advantages. Glycerine greatly simplifies the resin producer's problems of stock and handling. It is the most versatile of all the polyols, and therefore permits the resin manufacturer to make a variety of resins using just one polyol.

Glycerine is also preferred because of its better cooking properties, because it makes control of the manufacturing process easier, and because it imparts superior properties to so many resin formulations.

If you'd like detailed information on Glycerine's chemical and physical properties, write for your copy of "Why Glycerine for Alkyd Resins and Ester Gums?"-Glycerine Producers' Association, 295 Madison Avenue, New York 17, N. Y.

For more than 15 years, U.S. Industrial Chemicals Company, **Division of National Distillers Products** Corp., has used Glycerine to make "Arochem 520." An exceptionally pale, high melting point maleic resin, Arochem 520 imparts to coatings the properties of hardness, gloss, water-resistance, adhesion, and colorretention. Many protective coatings

for a wide variety of formulations, particularly furniture lacquers, sanding sealers, and tin-decorating finishes.

manufacturers choose Arochem 520

Nothing takes the place of Glycerine







Permutit Ion Exchangers increase resistance to corrosion, also eliminate chromate waste disposal problem

Ford's Kansas City aircraft plant keeps a sharp eye on every operation. Wings for Stratojets must have a perfect finish for aerodynamic smoothness... one that holds up in rough service.

Durable, hard coatings! The life of Ford's anodic film, its appearance and corrosion-resistance depend on water quality in the bath makeup, rinsing and hot sealing. As in most plants, their water supply contains dissolved minerals. Slight traces . . . but enough to interfere with Ford's rigid standards.

New method investigated! Ford engineers looked into the ion exchange process for demineralizing water originated by Permutit. Here's what they got with the help of Permutit engineers.

Improved corrosion-resistance!

Compact Permutit units (right) deliver mineral-free hot seal and rinse water . . . at the correct pH for best corrosion-resistance. The anion exchanger cuts chromate bills . . . recovers CrO₃ from dragout. This permits recirculating hot seals and rinses for big savings in fuel, water.

Waste disposal problem ended!

Recycling water solves most of the disposal problem. The balance is handled by the Permutit cation exchanger. It removes trouble-making aluminum from the anodizing bath at the rate of build-up. Wasteful draw-offs and dumpings are eliminated!

Combine these advantages and you'll find that you should consult Permutit with your problem. Write to The Permutit Company, Dept. CE-7, 330 West 42nd St., New York 36, N. Y., or Permutit Company of Canada, Ltd., 6975 Jeanne Mance Street, Montreal.

ION EXCHANGE HEADQUARTERS FOR OVER 40 YEARS

E PERMUTITE



it may be. For it is, quite literally, amazing how often the
unique properties of the finest diatomaceous materials (those which carry the Dicalite
name) have proved to be the key to new products or better processes. Chemically inert, being
practically pure silicon dioxide, very light in weight, with great surface area, Dicalite is
used in filtering everything from antibiotics to zein; as a bulking agent and filler;
as extender and as flatting agent; as a carrier and a diluent; and as insulation. As a
filteraid, Dicalite provides a wide range of uniform materials which afford
high throughput with filtration "sharp" enough to remove solids
in the size range of bacteria. • We will be glad to aid you in any
way we can. Our technical bulletins are free on request; we will
forward samples, sufficient for ample tests, if you will tell us what the problem is.
The services of our laboratories and technical department are yours



without obligation in the working out of special problems. Just write us.

DICALITE DIVISION, GREAT LAKES CARBON CORPORATION, 612 SOUTH FLOWER ST., LOS ANGELES 17, CALIFORNIA



ARE YOU PAINTING WITH APPLESAUCE?

Corrosive fumes and gases play havoc with "unprotected" structural steel walls and ceilings. But the selection of a satisfactory protective coating isn't always easy. A coating that adequately protects against fume "A" may fail in a week against fume "B."

Corrosion engineers know there is no "all purpose" protective coating. Wisely they steer clear of products whose makers claim *universal* "acid and alkali" resistance. They have learned through bitter experience that all too frequently they end up "painting with applesauce."

The fact that Tygon Paint — first marketed in 1939 — has grown increasingly popular with corrosion engineers, stems from two things:

1. It is a good protective coating

2. We're not affaid to admit its limitations Used as it should be used and under conditions for which it is suitable, Tygon Paint will out-perform and outlast practically any coating on the market. Fifteen years have proved it.

WRITE FOR THIS FREE BOOKLET

Bulletin 750 tells how and where to use Tygon Paint... how to make sure you're going to get adequate protection at minimum cost. Address Dept. BW\$54, The U.S. Stoneware Co., Plastics & Synthetics Division, Akron 9, Ohio.





Plastics and Synthetics Division

355-D

- A totally new adsorbent, made from crystalline zeolite, is being test marketed by Union Carbide. Processing removes water, leaves pores that preferentially adsorb small molecules over large, unsaturates over saturates, straight chains over branched.
- Newly-formed Olin Mathieson Chemical Corp. will definitely build a new cellophane plant at Red Bluff, Calif. This is in addition to a 33 million pound plant announced for Kern, Ind.

Northwest ammonia plant to use new process

An entirely new ammonia synthesis developed by L'Air Liquide of France will be coupled with hydrogen production from Bunker C fuel oil via a Texas Co. process at Columbia River Chemical's proposed ammonia-urea plant near Walla Walla, Wash. Fluor Corp., which has the exclusive North American license for the French process, will design and build the plant, expects completion late next year.

Initial economic studies were based on an \$11.5 million installation to make 160 tons of anhydrous ammonia, 110 tons of urea and 140 tons of ammonium sulfate daily. Actual capacity, however, is expected to be somewhat greater.

Fuel oil will be barged up the Columbia River. But provisions are being made for rapid conversion to natural gas as a source of hydrogen when and if it becomes available on an economical basis.

Another green-up time for chlorophyll?

Even the loss of outside sponsorship, caused by the break in the chlorophyll market, has not stopped chlorophyll research at Denver Research Institute. "Our preliminary studies held so much promise that we decided to continue the research on our own," says Charles H. Prien, head of chemistry and chemical engineering at the institute.

The most important finds so far suggest therapeutic uses for chlorophyllins in the treatment of tuberculosis and arthritis. Much of this work has been conducted by Joseph J. E. Schmidt. In addition, DRI is concentrating its research in these five fields:

- Deodorants—"Despite considerable unfavorable publicity, there is every indication chlorophyll derivatives have high value in this field."
- Foods—"There are encouraging indications of chlorophyll's value both as a pigment and as an aid to nutrition."
- Catalysis—"It could be used as a catalytic agent in chemical processing. It has never been tried on a commercial scale.
- Coatings—"It could be used in bags and for protective coatings on metals, foods, anything."
- Medical—Some aspects of the chemical structure chlorophyll closely resemble those of a specific antibiotic. Also, chlorophyll derivatives tend to seek out tissue that is in a state of healing, a characteristic of cancer. This indicates possible use as a carrier for taking radioactive materials to cancerous areas.

Prien cautions that "it's much too early to give results." But DRI is prepared to carry research forward "to the point where we can interest another sponsor. In one field—therapeutic applications—there is already enough promise to warrant a sponsor taking over the project."

Why Hyperflow works

In all its pilot plant work on the Hyperflow system for lifting solids, Union Oil Co. of California has used a tapered lift column to keep pressure drop per unit length constant from bottom to top. This maintains a constant gas velocity and avoids any turbulence within the line.

Hyperflow, generally referred to as a "reverse gravity" solids conveyance, or mass flow, is directly contrasted to conventional dilute phase lifting in which particles are suspended and dispersed from each other in a gaseous transport medium. Upward movement of solid particles is essentially the same in appearance as the downward flow of a bed of the same material in a gravity feed line.

In Union's pilot unit, the 25 ft. lift line, operating at 100 psi. on TCC pelleted catalyst, requires a taper from 12 in. at the bottom to 18 in. at the top. However, at higher pressure levels, where the expansion factor is less, there is less need for a tapered line. At 400 psi., according to Union, this factor would be so small that in almost every case, no taper would be needed at all.

But taper requirements also depend on the type of solid being transported and on the gas vehicle. Pelleted materials require more taper than granulated and gas density and viscosity affect the friction factor in the line.

And Union is careful to emphasize that taper alone is not the heart of the system. By not fluidizing granulated particles as they flow, and thus not introducing any relative movement between them, attrition loss is markedly cut.

Private butadiene plant still undecided

There's been plenty of talk recently about the first privately-financed butadiene plant—to be built somewhere in Texas. But reports have been so contradictory that some of the true details have been obscured. Here's the latest word:

If built, and the chances seem pretty good right now, the plant will cost \$26 million and have a combined capacity of 40,000 tons a year of butadiene and alkylate. It will include oversized facilities to make possible future expansion to 80,000 tons at an added cost of only \$7.5 million. Butadiene output will be priced at 14 c. per pound, as compared with the 16½-17 c. per pound expected when private industry takes over government-owned butadiene plants next year.

This big cut in selling price is not due to a new process, but to the fact that backers of the project are willing to accept a lower profit margin and a five year payout for the plant—rather a long time as chemical plants go. Engineering and economic studies by the Fluor Corp., Los Angeles, and by Purvin & Gertz, Dallas consulting engineers, show that this can definitely be attained.

And backers have already been lined up, by

William R. Staats & Co. of Los Angeles, for 100% of the equity money needed. Warren Petroleum Co. is expected to supply most of the raw materials.

The only remaining hitch seems to be signing of firm contracts—or something very close to them —for 25,000 tons per year of butadiene. This is complicated by the fact that even if construction were started today, production could not begin in time to be used initially in the rubber plants government is selling to industry.

However, a definite shortage of butadiene is expected by sometime in 1956, mostly in such markets as plastics, nylon and plastic paints. It's expected that users in those fields will be willing to contract now for production at that time. At least one such agreement has been negotiated.

Titanium: new processes, plants, outlet

A pair of new titanium processes, one for the metal, the other a mining operation, appear to be significant steps toward more economical production of the product. Both are of foreign origin.

In Montreal, Canada, the Shawinigan Water & Power Co. has succeeded in making about 10 pounds per day of high-grade titanium metal by a continuous electrolytic process. Construction of a larger pilot plant is now underway and should be finished this summer. If operations are successful in that unit, a third scale-up will follow, possibly to a unit big enough to constitute one cell of a commercial plant. Shawinigan is confident that its process will make possible much cheaper titanium.

And in South Africa, the Titanium Corp. of South Africa recently started operating an electromagnetic plant to make up to 300 long tons of ilmenite per day. This process is claimed to be able to produce and deliver ilmenite at New York cheaper than Americans can produce it from their own deposits.

Back in the U. S., a new company, Aero Metals Inc., has applied for a government loan (about \$4 million) to build a 1-ton-per-day titanium sponge plant. Aero's process would be the same as the Bureau of Mine's modified Kroll process—magnesium reduction of titanium tetrachloride. But the chances are slim, according to one government official. Aero wants a loan to cover both construction and initial operating expenses. Previous government loans—to Du Pont, Titanium Metals Corp. and Crane Co.—were for construction costs only.

But whether the Aero plant is built or not, the Office of Defense Mobilization is still vitally

(Continued on page 112)



%Proportioneers% Micro-Feeder answers the special needs of pilot plant or laboratory operations requiring continuous small quantity feeds with "absolute" accuracy, independent of viscosity or system pressure variations. Here is a compact, accurate charging system or test unit which gives uniform, reproducible conditions and quick, accurate prediction of the full scale end result.

A precision ground plunger is forced into the fluid-filled cylinder at a readily adjustable, predetermined rate. Since the fluid is forced out of the cylinder by the uniform progress of the screwdriven plunger, there can be no fluid loss due to valve action or changes in plunger speed. The cylinder may be jacketed or insulated to maintain uniform conditions. The standard Micro-Feeder is available in models for feeding from 1.0 cc to 800 cc per hour and for maximum discharge pressures up to 2000 psig. Special Micro-Feeders can be furnished for other conditions.

Micro-Feeder Applications include . . .

- 1. Catalyst Testing
- 2. Additive Injection
- 3. Carburetion of Fuels
- 4. Explosive Mixture Analysis
- 5. Calibrating Instruments
- 6. Porosity Determination
- 7. Laboratory Titration
- 8. Injection of Vitamin Concentrates
- 9. Toxicity Measurements

Ask for recommendations and Bulletin SM-3005-2.
Write Proportioneers, Inc., 369G Harris Avenue, Providence 1, R. I.

ROPORTIONEERS

DIVISION OF B-I-F INDUSTRIES, INC.



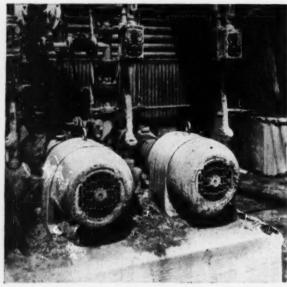
TECHNICAL SERVICE REPRESENTATIVES IN PRINCIPAL CITIES OF THE UNITED STATES, CANADA, MEXICO AND OTHER FOREIGN COUNTRIES



ADVICE: Replace switches and fuses with compact G E switchgear designed with adequate interrupting capacity. Place the equipment in ventilated room to combat corrosion.

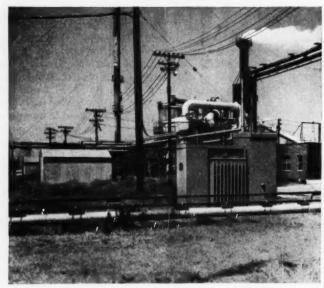
RESULT: Reliable primary power service from main substation. Corrosion problems minimized. Pre-assembly of this metal-clad switchgear at factory cut installation time.

G.E. helps convert wartime plant



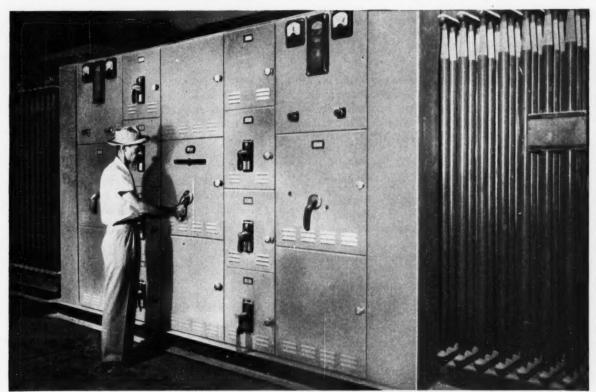
ADVICE: Replace open motors in corrosive areas with G-E totally enclosed, fan-cooled, corrosive resistant Tri-Clad* motors. RESULT: G-E motors, such as these driving recirculating pumps, last longer, require less maintenance.

Reg. Trade-mark of General Electric Company.



ADVICE: Place this 500-kva load-center substation near work load which is remote and in less corrosive atmosphere.

RESULT: Reliable power supply, fewer power lines from primary station, selective fault isolation of secondary circuits.



ADVICE: Replace open pole lines for primary distribution with armored cable. Install G-E double-ended load-center unit substation in ventilated room in center of load area.

RESULT: Fewer and better protected primary lines. Selective tripping of load-center circuit breakers limits secondary power outages to faulty lines. Additional units may be added in the future.

into efficient fertilizer producer

Step-by-step installation of G-E electrical system keeps production smooth at ex-superphosphate plant

A large chemical company operates a superphosphate plant built during World War II, which has been converted to the manufacture of a high-grade fertilizer. The plant's electrical equipment needed to be replaced—and without interrupting production.

General Electric engineers—called in on the problem—made an extensive plant survey and recommended a step-by-step electrical modernization program. The program as adopted combined latest techniques and modern equipment to effectively combat the extreme corrosion caused by sulphuric acid, phosphoric dust, and other chemicals.

In succession, a compact G-E primary substation was installed in a ventilated roomvulnerable power lines were replaced with G-E armored cable—G-E unit substations were located near load centers to cut power losses—and open motors were replaced by G-E totally enclosed motors designed for chemical service. Result: the company reports complete satisfaction with the system.

Whether you plan to build, expand, or modernize a chemical plant, you too can profit by the services of G-E specialists in application and field engineering. These and other specialized engineering services are available to you through your local G-E Apparatus Sales representative. Call him early in your planning stage. General Electric Company, Schenectady 5, N. Y.

Engineered Electrical Systems for the Chemical Industry



interested in stimulating titanium production. Latest move was a plan to buy up any of the metal that becomes surplus to military or atomic energy needs. First purchases were from Du Pont (1.25 million pounds) and Titanium Metals (600,000 pounds).

Major rival coming for phthalic anhydride

First commercial production of isophthalic acid will begin in the middle of next year. By that time Oronite Chemical Co., a subsidiary of Standard Oil Co. (Calif.), expects to have its 50 million pound per year plant on stream at Standard's Richmond, Calif., refinery.

Starting with 95 + % m-xylene, Oronite will turn out a product containing 98% isophthalic and 2% terphthalic acids. A 98% product from 95% feed results through oxidation of ethyl benzene and o-xylene, which drop out as benzoic acid during processing operations.

Full development of isophthalic acid should open the door to small resin operators who have been handicapped by the high cost of equipment needed to process phthalic anhydride. Isophthalic's low volatility in the alkyd kettle reduces acid loss and eliminates the necessity for closed kettles.

Also, whereas phthalic anhydride resins discolor rapidly above 500 F., alkyd resins made with isophthalic can be cooked at oil bodying temperatures as high as 600 F. without more than normal oil decomposition. Higher temperatures, of course, permit shorter cooking times.

Most likely isophthalic applications are in fastdrying, thermally stable oil-modified alkyd resins (where the higher molecular weight resins attainable enable manufacturers to produce superior alkyd vehicles at a lower cost than is possible using phthalic anhydride), low pressure laminating polyesters, polyamide resins and alkyd oils.

Price of commercial isophthalic is expected to be about 3 c. per lb. higher than phthalic anhydride—currently at 20 c. per lb. And since the major isophthalic markets are in the East, Oronite is establishing a large storage and distributing terminal in New Jersey.

New treatment cuts phenol pollution

Two unique features—tower design and type of solvent—highlight a new full-scale waste treatment unit just installed by Koppers Co. at its Follansbee, W. Va., tar products plant. Liquid-liquid extraction removes 99% of the phenol present in the plant's effluent water, reducing phenol content

to 0.005%. Previously, process water contained up to 0.3% tar acids.

The new unit is the first commercial application of a Koch Kascade-tray tower in phenol-fromwater separation. Advantages cited by Koppers are high stage efficiency, high liquid load and consequent high efficiency.

But the new tower shares the stage with the new solvent employed—a light fuel oil fortified with pyridine type bases to increase the solubility of phenol in the hydrocarbon. Phenol, in turn, is extracted from the oil by caustic soda. Chemicals recovered are expected to offset part of the \$30,000 annual operating cost.

Capacity of the half-million dollar plant is about 200,000 gal. of contaminated water daily. This is well over the average of 100,000 gal. a day now emanating from the Follansbee plant.

Oliu Mathieson-fourth biggest

Merger of Mathieson Chemical Corp. and Olin Industries into Olin Mathieson Chemical Corp. has catapulted a new giant into our midst. Based on 1953 operating figures, the combine expects sales to top \$500 million this year. Assets, too, exceed the half-billion dollar mark (\$339 million for Mathieson, \$233 million for Olin, as of last Dec. 31).

Thus the new firm becomes the fourth biggest U. S. chemical company, ranking behind DuPont, Union Carbide and Allied, but well ahead of Dow, American Cyanamid and Monsanto. And there's no indication that the new management means to stop there. As one Wall Streeter phrased it, all concerned "have a psychological feeling they want to be a second Du Pont."

First move toward this "goal" came in June 1953 when the two firms formed the Matholin Corp. to make and sell hydrazine. Successful joint operations there definitely catalyzed the complete merger, which had been under consideration for about two years.

The latest move's immediate advantages for both parties are readily apparent. Mathieson's raw material production fits right into Olin's operations, particularly chlorine, caustic and ethylene for cellophane and polyethylene. And Olin, long a maker of ammunition and other defense goods, gets its oft-expressed wish for a broader operational base.

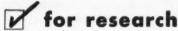
Another important asset is that neither firm has competed with the other in any field. Olin's \$228 million sales last year were in metals and fab-

(Continued on page 114)



of these **Fluorine Compounds**do you need?

for process uses



FLUORINE Elemental Fluorine

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Fluoboric Acid
Fluosulfonic Acid
Hydrofluoric Acid, Anhyd.
Hydrofluoric Acid, Anhyd. High Purity
Hydrofluoric Acid, Aqueous Tech.
Hydrofluoric Acid, Aqueous, Purif. & Reag.

ACID FLUORIDES
Ammonium Bifluoride
Potassium Bifluoride
Sodium Bifluoride

ALKALI FLUOBORATES Ammonium Fluoborate Potassium Fluoborate Sodium Fluoborate

ALKALI FLUORIDES Ammonium Fluoride Potassium Fluoride, Cryst. & Anhyd. Sodium Fluoride, Tech. Sodium Fluoride, Reagent

DOUBLE FLUORIDES
Chromium Potassium Fluoride
Potassium Firric Fluoride
Potassium Titanium Fluoride
Potassium Zirconium Fluoride
Sodium Zirconium Fluoride
Sodium Silico Fluoride
Potassium Aluminum Fluoride

METAL FLUORIDES Aluminum Fluoride Aluminum Fluoride, Crystal Fluorides Antimony Pentafluoride First
Barium Fluoride
Cadmium Pluoride Cadmium Fluoride Calcium Fluoride Chromium Trifluoride Cupric Fluoride Ferric Fluoride Lead Tetrafluoride Magnesium Fluoride (Not Optical Gra Mercuric Fluoride Manganese Trifluoride Molybdenum Hexafluoride Nickelous Fluoride Selenium Hexafluoride Silver Diffuoride Strontium Fluoride Titanium Tetrafluoride Tellurium Hexafluoride Tungsten Hexafluoride

NON-METALLIC FLUORIDES Boron Fluoride Gas Boron Fluoride Ether (Diethyl) Complex

Zinc Fluoride Zirconium Tetrafluoride Boron Fluoride Phenol Complex
Boron Fluoride Ammonia Complex
Boron Fluoride Diacetic Acid Complex
Boron Fluoride Di-n-Butyl Ether Complex
Boron Fluoride Di-nydrate
Boron Fluoride Piperidine Complex
Boron Fluoride Piperidine Complex
Boron Fluoride Hexamethylenetetramine Complex
Boron Fluoride Monoacetic Acid Complex
Boron Fluoride Para-cresol Complex
Boron Fluoride Triethanolamine Complex
Boron Fluoride Urea Complex
Boron Fluoride Urea Complex

METAL FLUOBORATE SOLUTIONS
Cadmium Fluoborate
Chromium Fluoborate
Cobalt Fluoborate
Copper Fluoborate
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Indium Fluoborate
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HALOGEN FLUORIDES Bromine Trifluoride Bromine Pentafluoride Chlorine Trifluoride Iodine Pentafluoride

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GENETRON® ORGANIC FLUORINE COMPOUNDS Fluoromethanes Trichloromonofluoromethane CCI₂F₂ CHCIF₂ Dichlorodifluoromethane Monochlorodifluoromethane Trifluoromethane (Fluoroform) CHF₃ Monochlorotrifluoromethane **Fluoroethanes** Difluoroethane (Ethylidene fluoride) CH3 · CHF CH₃ • CCIF₂ CCI₃ • CCIF₂ CH₂CI • CF₃ CCI₂F • CCIF₂ Difluoromonochloroethane Tetrachlorodifluoroethane Monochlorotrifluoroethane Trichlorotrifluoroethanes CCI₃ • CF₃ CCIF₂ • CCIF₂ CCI₂F • CF₃ Dichlorotetrafluoroethanes Monochloropentafluoroethane CCIF2 . CF3

Dibromodifluoroethane

Fluorinated Acetic Acids and Anhydrides

Dichloromonofluoroacetic acid and anhydride

Monochlorodifluoroacetic acid CCI₂FCOOH and CCI₂FCOOH and CCI₂FCOOH and CCI₂FCOOH and

and anhydride $(CCIF_2CO)_2O$ Fluorinated Acetones

Tetrachlorodifluoroacetone $CCI_2F \cdot CO \cdot CCI_2F$ Trichlorotrifluoroacetone $CCI_2F \cdot CO \cdot CCI_2F$ Dichlorotetrafluoroacetone $CCI_2F \cdot CO \cdot CCIF_2$

Various Other Organic Fluorine Chemicals

Through aggressive research and development, General Chemical sets the pace in fluorine chemistry . . . making more and more of these versatile chemical "tools" available so that your development program today can become tomorrow's production.

Listed here are a hundred organic and inorganic fluorine compounds which General presently offers. Many are produced in carload, tank car or other commercial quantities. Others are made in pilot plants or intermittently on a laboratory scale for

re made in pilot plants or intermittently on a laboratory scale for experimental uses. For some of these, studies of properties are in early stages. General has a number of other fluorine products under investigation in addition to those on the list; thus the company is geared to serve you well—now—and in the future.

That's why it's wise to see General Chemical when your work indicates the need for fluorine chemicals. With fifty year's experience in the field, we may be able to save you time, money and effort.

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ricated parts, industrial explosives, ammunition, cellophane, polyethylene, fine papers and other products. Mathieson, on the other hand, sold \$244 million worth of industrial chemicals (soda ash, caustic, chlorine, sulfuric acid, ammonia and methanol), ethylene and ethylene derivatives, agricultural chemicals and fertilizers, and pharmaceuticals, the last through its E. R. Squibb division.

Final details and approval will be decided by the stockholders at a special meeting called for June 29. The proposed plan provides for stockholders in both companies to receive one share of Olin Mathieson stock for each share held. Preceding the transfer, however, Mathieson stockholders will receive a 5% stock dividend.

Coal gasification project due for new life

There's a very strong possibility that the Hydrofrac process for rejuvenation of oil wells—hydraulic fracturing of underground strata—will be adapted to underground coal gasification.

Legal experts for the Interior Department's Bureau of Mines, Alabama Power Co. and Stanolind Oil & Gas Corp. are now drawing up an agreement through which studies of underground gasification of coal will be re-started. If agreement can be reached, the Gorgas, Ala., gasification project, in standby since May 1953, will be put back into operation.

The Bureau of Mines previously entered into a cooperative agreement with Stanolind and the Halliburton Oil Well Cementing Co. to use Hydrofrac to prepare a passage in the coal bed prior to ignition and gasification. But when Congress denied funds to gasification projects, the experiments couldn't be carried out.

Alabama Power's interest in gasification is as an efficient way to use its coal reserves for generating electric power. Stanolind—which also has coal reserves of its own—would naturally be interested in gasification as a source of synthesis gas, especially since its recent acquisition of the Carthage Hydrocol installation in Brownsville, Tex.

A twenty-nine way stretch

One of the last companies to get into the bidding on government-owned synthetic rubber plants, and certainly the most thickly-populated, is the American Synthetic Rubber Corp. Owned jointly by 29 companies which authorized a total capital of \$6.6 million, the new firm submitted only one bid, for a GR-S plant.

Leader in the venture was Thomas Robins,

Jr., president of Hewit-Robins, Inc., and Kentucky Synthetic Rubber Corp. But the biggest share-holder in the combine is American Cyanamid (\$2 million)—also the only nonconsumer of rubber in the group. Cyanamid will market its portion of plant output to customers outside the coalition through its technical service sales organization.

Subscriptions by the 29 companies ranged upward from \$5,000. If a plant is obtained, each consumer-stockholder will receive a basic allotment of about 500 tons of rubber per year per \$50,000 of investment. However, any allotment can be refused without penalty.

Why was the group formed? According to Mr. Robins, "The combination of American Cyanamid's outstanding research facilities and background in petrochemicals research, with the group's plant operation know-how, gives reasonable assurance that American Synthetic, if it gets a plant, can contribute much to the future development and improvement of synthetic rubber."

Water reclaiming insures constant supply

For many, California's water problem far outstrips its smog and traffic miseries. To help ease the acute shortage in one community, Ventura, Shell Oil Co. is building a plant to take waste water being discharged into the ocean from the city's sewage disposal plant and reclaim it for industrial use at a maximum rate of 2 million gallons a day.

This is the first such plant built in the West by a private company. By agreement, Shell will pay for plant operations for 20 years, at which time title goes to the city. In exchange, Shell will receive free water during the 20 year period.

In the first stage of water reclamation—stage filtration—sewage water filters through six feet of graded rock in each of two tanks to remove some of the larger solids. Next it is dosed with chemicals. These inactivate bacteria and mix with microscopic foreign elements, adding to their weight so they sink to the bottom.

Final purification, including chlorination, is similar to that used in conventional water filtration plants. And effluent water, though destined only for industrial uses, is pure enough to drink.

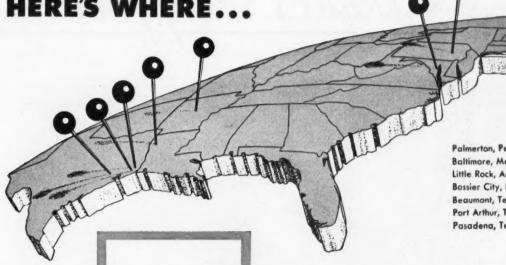
Initial production is scheduled at 1.5 million gallons daily, all for Shell's use. This output will largely eliminate the need for emergency wells during the summer and will allow the city to allocate more water to residential areas.

What's Happening . . . page 116

MATHIESON SULPHURIC ACIDA

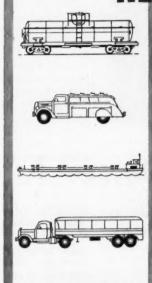






Palmerton, Pennsylvania Baltimore, Maryland Little Rock, Arkansas Bossier City, Louisiana Beaumont, Texas Port Arthur, Texas Pasadena, Texas

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Transportation techniques, from plants and key shipping points, to fit your requirements. Tank car deliveries available from the seven shipping points listed above, with tank trucks, tank barges and tank transports available in certain areas.

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Quality chemicals, PLUS dependable delivery schedules, PLUS flexibility in handling spent acid problems, add up to why you can buy to better advantage from Mathieson.

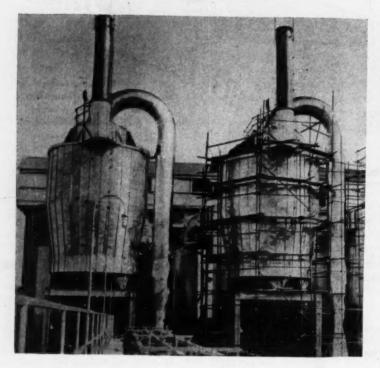


MATHIESON CHEMICAL CORPORATION

Mathieson Industrial Chemicals Division **Baltimore 3, Maryland**

CAUSTIC SODA . SODA ASH . CHLORINE . SULPHUR . SULPHURIC ACID . BICARBONATE OF SODA SODIUM NITRATE . NITRIC ACID . SODIUM METHYLATE . AMMONIA . HYPOCHLORITE PRODUCTS DRY ICE AND CARBONIC GAS . ETHYLENE GLYCOLS AND OXIDE . METHANOL . SODIUM CHLORITE JULY 1954

What's Happening



Lignite: Fuel and Chemicals

New dryers (above) prepare lignite for use as fuel in electric power generators. But product's biggest future may be as a source of commercial tars.

For the first time lignite is being used to generate electric power for smelting aluminum—at Aluminum Co. of America's new 90,000 ton per year Rockdale, Tex., works. When producing at capacity this plant will use nearly 5 million kwhr. of electricity daily.

But that's not all. Alcoa is looking forward to the day it can ob-

tain tars of commercial value by low temperature carbonization of the lignite before it's used for fuel. Pilot plant studies are now being conducted at Rockdale.

Both the drying and carbonization processes were developed by V. F. Parry of the Bureau of Mines in cooperation with Texas Power & Light Co. and Alcoa. For now,

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More Hydrofining Capacity146

the power facilities—run by TP&L—use dried lignite, not lignite char, the end-product after carbonization.

Crushed raw, wet lignite is suspended in the drying column in a turbulent state. It's dried by the combustion products of lignite dust with air and recirculated gases, which enter at about 1,500 deg. F. and \$\frac{1}{2}\$ psig. The exit temperature is normally about 300 deg. F. Approximately 94 percent of the dried dust settles out in a primary separator, the balance in a secondary cyclone separator.

Dried lignite dust is fed to the carbonizer, resulting tars being recovered by a tar-condensing system. No commercial worth has been established for these tars yet since they have never before been available in sufficient quantities to justify large-scale research. But the experience gained during the next several months of pilot plant operation is expected to determine the economics of the process, as well as a design for a commercial unit.

in Chemical Engineering



Air, Water, Power-Plus Engineering Skill

This new ammonium nitrate plant is Iceland's entree into chemicals. Small by U. S. standards, cheap power keeps costs in line.

Technical and economic assistance provided by the United States; equipment built in Switzerland, France, Italy and England; locally developed hydroelectric power—these are keys to the success of Iceland's first venture into chemical manufacturing.

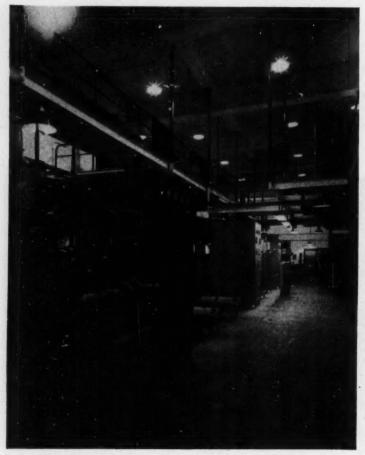
Seen above is the new ammonium nitrate plant of Aburdarverksmidjan H. F. (The Fertilizer Plant, Inc.), which went into production this spring. It parlays air, water and power into fertilizer, via electrolytic hydrogen, air fractionation, ammonia synthesis, ammonia oxidation to nitric acid and reaction of ammonia with acid to make crystalline ammonium nitrate.

The new plant, built at a cost

of \$7½ million, is Iceland's largest single industrial facility. Consultant Charles Owen Brown collaborated with Singmaster & Breyer of New York in plant design and project management.

▶ Based on Power—Iceland's most important natural resource is hydroclectric power. Water flow is dependable the year round, and the power industry has several modern stations. In fact, power for the fertilizer plant—to the tune of 16,000 kw.—comes from a new generating station of the Sog Power Co.

Taking advantage of the avail-



POWER is supplied to hydrogen cells through these rectifier controls.

ability of cheap power, the new venture converts Iceland's economy from a net importer of nitrate to a net exporter. While this plant is small compared with U. S. standards—30 tons per day of ammonia, 70 tons per day of nitrate—its surplus production over domestic needs is expected to be competitive in the world market.

▶ Process Technology—With a single major exception, plant operation is based on modern, but otherwise conventional, process technology. Hydrogen is made by electrolysis of water in 384 cells. Nitrogen comes from a L'Aire Liquide air separation plant. (Byproduct oxygen is at present wasted.)

Ammonia is synthesized from nitrogen and hydrogen at 5,150 psi. Part of the ammonia is oxidized with air to get nitric acid.

Novel step in the process is the

way that ammonium nitrate is made. The new plant uses a continuous two-stage crystallization system in which the anhydrous ammonia and 60-percent nitric acid react, with the liberation of enough heat to evaporate all the water introduced by the nitric acid. Evaporation is divided between the two stages. Crystalline product, which is relatively uniform and dust-free, is coated with diatomaceous earth.

Watch for a detailed, illustrated description of this plant's operations in an early issue.

New Company Begins New Oil Refinery

Construction has started near Montreal on a complete \$20 million, 20,000 barrel per day refinery for a new oil company, Canadian Petrofina, Ltd. M. W. Kellogg Co., New York, is designing the major part of the processing units, all with flexibility to handle both Middle East and Venezuelan crudes.

Processing facilities, to be built by Canadian Kellogg Co., Ltd., include a 20,000 bpd. topping unit, vacuum flashing capacity of approximately 10,000 bpd., a 4,000 bpd. visbreaker, a 3,600 bpd. cat reformer, catalytic polymerization and alkylation units, a 2,500 bpd. distillate treating unit and a 6,500 bpd. gasoline treater. Completion is scheduled for the latter half of 1955.

GAF Schedules New Chlorine-Caustic Plant

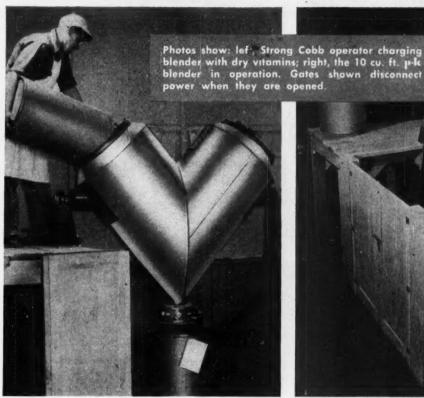
Plans have been completed by General Aniline & Film Corp., New York, for construction of a \$3 million, multi-product, chlorine caustic plant near Linden, N. J. Much of the output will be used in the company's dye and chemical operations at Linden and at Rensselaer, N. Y. Additional production will be available for sale.

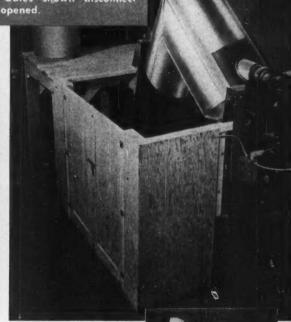
Rated capacity of the plant will be 26 tons of chlorine per day. But it will also produce high purity caustic soda in flake form and in 50 percent solution, caustic potash in flakes and in 45 percent solution, muriatic acid and sodium hypochlorite.

Hydrogen Peroxide Coming by New Process

Solvay Process Div. of Allied Chemical & Dye Corp. has a new method for making hydrogen peroxide. In contrast with older electrolytic processes, it involves chemical oxidation using raw materials mainly available within the Allied organization. The company believes that its new process is the most advanced and efficient that has been developed to date for manufacture of hydrogen peroxide.

Engineering and design work for a new plant employing the method is already under way. It will be installed at one of Solvay's present plant locations.





UNITED PRESS

How STRONG COBB & CO. CUT DRY BLENDING TIME BY

Dry ingredients blend thoroughly and uniformly in p-k twin shell blenders* in only 1/10 the time required by other dry blenders, according to Strong Cobb & Co., Inc., Cleveland. They also pointed out that p-k twin shell blenders are much easier to clean than other blenders.

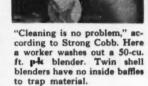
Strong Cobb manufactures drugs and pharmaceuticals to private formulas. Thorough blending, consistant uniformity from batch to batch, and clinical cleanliness are, of course, all-important to such products.

"We would recommend the twin shell blenders to others," say Strong Cobb. "For all types of mixes, they are fast, clean and positive. Loading and unloading is quick and easy."

Your mixing operation may call for a standard p-k twin shell dry blender, screw-feed or intensifier model. Perhaps a double cone or ribbon blender may be right for you. Because p-k manufactures all three kinds, you can be sure of impartial information to help you select the right blender to fill your needs.

Write now for Catalog No. 12, which includes complete engineering data —or send samples of materials for analysis of blending.







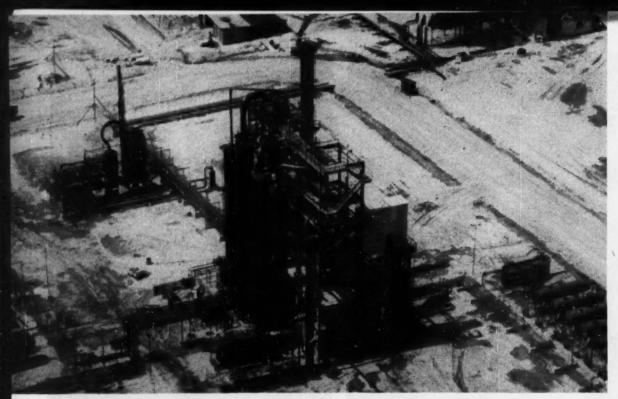




the Patterson-Kelley Co., inc.

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SIMPLE PROCESS FLOW through three major plant areas is an important feature of this latest styrene monomer plant.

New Styrene Entry Takes Different Tack

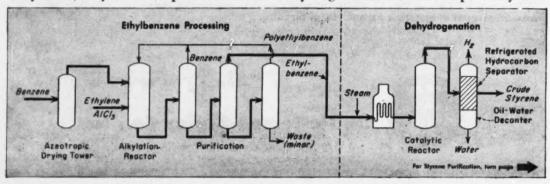
Undaunted by warnings that styrene plants must be big, a new producer has just gone on stream with a process especially designed for medium-size operations.

Although probably the smallest styrene monomer producer in the country, Foster Grant Co. (headquarters at Leominster, Mass.) has accomplished something none of the big boys has—complete vertical integration. With the opening of its new styrene plant in Baton Rouge, La., recently, the company became the first to combine production of monomer with molding of finished polystyrene consumer goods.

And the final step came via a

new monomer process. The plant is the first of its type to operate without license from Dow Chemical Co. and the first since before World War II to be built without government subsidy.* What's more, Foster Grant will have invested only \$4 million when capacity production of 24 million pounds a year is reached. Most

Alkylation, ethyl benzene purification and dehydrogenation are first steps to styrene.



Carbide and Carbon Chemicals Co. has also made styrene without a Dow license, but started with acetaldehyde rather than ethylene and benzene.

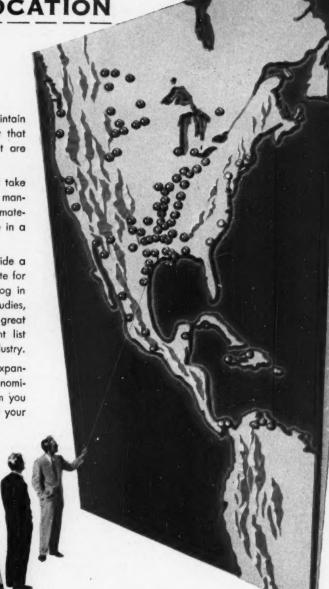
OPERATING COSTS...
AND PLANT LOCATION

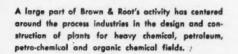
The ability of a company to make and maintain cost reduction is especially significant now that vigorous competition and a buyers' market are back.

Shrewd selections of plant locations that take advantage of new developments, available manpower, transportation, low-cost power and material handling, can well mean the difference in a healthy profit or a ruinous loss.

In locating plants and facilities that provide a low basic operating cost, there is no substitute for experience. Brown & Root's years of backlog in the process industries embraces location studies, engineering, and construction of plants in a great variety of endeavor. Brown & Root's client list takes on the aspects of a "Who's Who" in Industry.

If you are planning new construction or expansion, Brown & Root's experience in fast, economical completion can benefit you. A call from you will put Brown & Root's planning experts at your disposal. No obligation, of course.





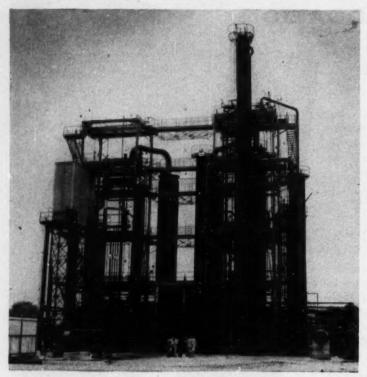




BROWN & ROOT, INC. Engineers Constructors

O. BOX 1. HOUSTON 1: TEXAS

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FIVE TOWERS are necessary to make pure ethyl benzene for dehydrogenation.

experts have heretofore maintained that the minimum size plant needed for economical operations would cost \$10 million.

▶ Similar But Different—In many ways the new process resembles Dow's. Benzene and ethylene are alkylated to ethyl benzene. This is then dehydrogenated to styrene monomer, which is separated by vacuum distillation from unreacted ethyl benzene.

But in several details, Foster

Grant's method is unique, enough so that there is no question about possible patent infringements.

First, the design of the dehydrogenerator is based on early German patents, bolstered by original work done by the company's engineers. Secondly, arrangement of the distillation equipment is extremely simple and is giving more effective and more economical separations. Finally, in the styrene purification step, hydroquinone is used to inhibit polymerization rather than the elemental sulfur used by Dow.
Phow It's Done—Both starting materials come from Esso's near-by refinery, benzene in tank cars, ethylene via pipeline. After azeotropic drying of the benzene, the reactants are mixed with aluminum chloride catalyst and a small amount of ethyl chloride in the alkylation reactor (see flowsheet). Alkylation products are roughly 35 percent ethyl benzene, 15-20 percent polyethyl benzenes and 45 percent unreacted benzene.

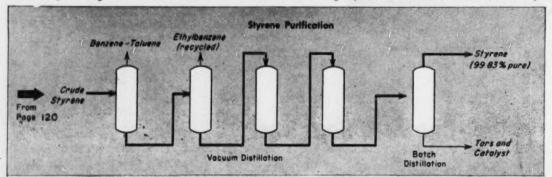
Three-stage purification of ethylbenzene follows. Pure EB is sent to the catalytic dehydrogenation section of the plant. Benzene from the first fractionator and polyethyl benzenes from the third-by vacuum distillation—are recycled to the alkylation reactor.

▶ Steam Plus Heat—It's necessary to add about 2.6 lb. of steam per lb. of ethyl benzene prior to dehydrogenation in order to reduce the partial pressure of the products. This mixture is then heated and passed over an iron oxide catalyst (Shell 105). Hydrogen splits off and the reaction products—now mostly styrene monomer and unreacted ethyl benzene—are condensed.

Processing in a novel, four-way tower is the next step. The condensed products are scrubbed, refrigerated and decanted from the water. Hydrogen gas is vented from the top. A 35-40 percent styrene yield (based on ethyl benzene) is obtained.

► Tough Separation-By far the

Final styrene purification is difficult because heat polymerizes monomer so readily.



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Car repair shops throughout the U. S. A.



7 GENERAL AMERICAN TRANSPORTATION CORPORATION 135 South La Salle Street, Chicago 90, Illinois Offices in principal cities most difficult step in making styrene monomer is separating it from unreacted ethyl benzene. Compounding the problem is the fact that styrene polymerizes so easily. Therefore, both vacuum distillation and a polymerization inhibitor are required to overcome the effects of high pressure drop and the large number of plates.

Foster Grant has overcome the situation by first distilling off the small amount of benzene-toluene present, then adding hydroquinone as an inhibitor and vacuum distilling in a series of three columns which operate as a single tower with 70 theoretical plates. Ethyl benzene recovered is recycled to the dehydrogenation reactor and styrene monomer, mixed with tars and catalyst, goes to run-down tanks.

As large enough monomer quantities are accumulated, a final separation is effected from the tars and catalyst by batch distillation. Styrene-over 99.8 percent pure-is then refrigerated and shipped to the company's Leominster, Mass., plant for polymerization.

A polymerization inhibitor is also required during the shipping. Like Dow, Foster Grant uses p-tertbutyl catechol.

► Maximum Standardization—Spare parts required have been kept to a minimum by an all-out effort to standardize both equipment and instruments. For instance, only two major pump types are used, one filling 80 percent of the plant's needs. Also, all relief valves, flow controllers and recorders are of one standard design.

Manpower requirements are minimized, too, by emphasizing automatic controls. Four skilled operators per shift handle all the units. In addition, three engineers, headed by plant manager F. Drew Mayfield, are responsible for planning and supervising over-all operations. ▶For the Future-All styrene monomer made in this Baton Rouge plant is captive production, at least for now. But company management is already talking about expansion. If and when that happens, Foster Grant fully expects to become an active seller of this important chemical intermediate.



California Sunshine at Work

Convair's solar furnace can produce temperatures as high as 8,500 deg. F. for testing properties of metals and ceramics.

Hottest spot on earth-that's the focal point of this solar furnace now being used by engineers at Consolidated Vultee Aircraft Corp. for testing basic properties of materials at high temperatures.

With ideal sky conditions, estimated temperature at the fe-in.dia, focal point of the parabolic reflector is 8,500 deg. F. This is well above temperature levels achieved by the oxyacetylene torch (5,800 deg.) and the carbon are (6,300 deg.).*

Basic part of the solar furnace is

the 120-in.-dia. polished aluminum

mirror. Radiation from the sun is collected by the mirror and reflected to the focal point at a distance of 34 in. from the center of the mirror.

▶ Follows the Sun - In order to keep the focal spot in one location over an extended period of time, the mirror is mounted in a gimbal ring so that the polar axis of the mounting is parallel to the earth's axis. A clock mechanism driven by a synchronous motor coordinates movement of the mirror with that of the sun.

Sky haze and clouds greatly reduce the efficiency of the solar furnace. In order to obtain more





TOP ENTERING... turbine and paddle types. Sizes 1 to 500 HP.



SIDE ENTERING



Even an ACCIDENT can't hurt the gears in this fluid mixer!

Specify LIGHTNIN Turbine or Paddle Mixers-and you'll never have to worry about shaft flexure being transmitted to the gears of the speed reducer.

Even if one of your operators accidentally drops a sack of solid material into the tank while the mixer is running, the shock load never gets back to the vital parts of the mixer drive.

Notice how the mixer shaft passes through the hollow quill of the speed reducer.

See how the mixer shaft and hollow quill are connected at only one point-by a flexible coupling. The coupling soaks up all the strain . . . isolates and protects the gearing.

That's one big reason why you get

years and years of trouble-free, low-cost operation with LIGHTNIN Mixers.

There are many more good reasons



1. SPEED REDUC-ER GEARS are protected in LIGHTNIN Mixers, by this hollow-quill construction.



2. MIXER SHAFT



(greatly exagger-ated here) can neverreach gears, bearings, and other parts of speed reducer. All shock loads why you cut costs with LIGHTNINS. Versatility, for example. The turbinetype LIGHTNIN Mixer you buy today can keep on serving you even if your process should change tomorrow. You can change the tank mounting, shaft, impellers, to meet new mixing requirements. You can even interchange speeds-by replacing two easy-to-get-at gears.

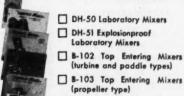
Finally, you're protected process-wise when you choose LIGHTNIN Mixers. Every LIGHTNIN is unconditionally guaranteed to do the mixing job right.

Your LIGHTNIN Mixer representative can tell you more about the long-term savings you can make with LIGHTNINS. You do not obligate yourself in any way -so why not give him a call right now.

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LIGHTNIN Catalogs contain practical data on impeller selection; sizing; best type of vessel; installation and operating hints; full description of LIGHTNIN Mixers. Yours without obligation. Check and mail coupon today.

MIXCO fluid mixing specialists



☐ 8-104 Side Entering Mixers **8-105 Condensed Catalog** (complete line)

☐ B-107 Mixing Data Sheet

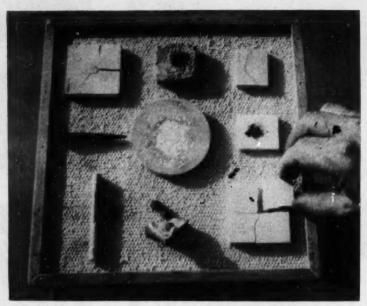
☐ 8-108 Portable Mixers (electric and air driven)

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Company	
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REFRACTORY samples fail under intense radiation of solar furnace.

dependable performance, Convair plans to move the equipment from its present San Diego, Calif., location to a nearby mountain toppossibly Mt. Palomar-where sky conditions would be vastly superior. ► Materials Testing—The solar furnace is eminently suited for testing materials at high temperatures. The heat is "clean"—there is no interference from combustion products or other possible contaminants. Nor is there any interference from electric or magnetic fields. Heat-treating or melting and freezing of samples can be observed up to the highest temperatures available, and heating and cooling times are very short. And any other type of furnace which even approaches these temperatures would face the problem of preventing the furnace structure itself from melt-

Materials to be tested can be enclosed in a quartz envelope filled with any desired atmosphere. The glass itself, outside the focal point, is not destroyed by the high temperatures at the focal point within.

A bridge structure spanning the mirror a short distance beyond the focal spot supports the specimen holder. After part of the sample melts, adjacent regions are moved into the focal spot by means of a

motor-driven screw. The bridge also supports a cylindrical barrel about 18 in. in diameter. This is used to shade a part of the mirror from the specimen so that the intensity of solar radiation concentrated on the specimen can be controlled.

The mirror has a central opening 22 in. in diameter which permits easy observation of the focal spot area from a position on the ground behind the mirror. A telescope mounted at this opening permits the observer to see details of heating or melting, magnified about 20 times.

Convair is testing many different kinds of materials, both ceramics and metals. Information developed in this program is expected to be of great value in solving problems associated with engines and friction.

New Tests Completed on Sea Water Distillation

Thermocompression distillation of sea water into drinking water will soon be more rapid and economical, according to the Army's Engineer Research and Development Laboratories, Fort Belvoir, Va. Recent tests by ERDL have determined the most effective means of controlling scale formation in equipment—until now the greatest obstacle to an economical process.

In the thermocompression method, steam from boiling sea water is compressed and recycled to maintain the boiling action. As latent heat is transferred, the steam condenses to form pure, salt-free distillate. Scale deposited on evaporator tube surfaces, however, has in the past doubled the cost of distillation due to lost capacity and efficiency, and the additional labor and materials required.

Now Army scientists have found that frequent descaling with citric acid while distillation is in progress is the key to indefinite maintenance of production in field units. They've devised a simple procedure that minimizes corrosion hazards of the acid, time out for cleaning and other interferences.

In addition, the investigation showed that descaling can be reduced to a minimum in permanent or semi-permanent installations by using brine stabilization equipment. This method provides a stabilizer of suspended solids on which the greater part of the scale is deposited. In some instances it has increased unit production twenty times.

New Instrument Plant Will Cost \$4 Million

Plans to build "the world's most modern instrument plant" near North Wales, Pa., have been completed by Leeds & Northrup Co. of Philadelphia, Pa. Total cost will exceed \$4 million.

Construction is scheduled to start in the early fall, with occupancy late in 1955. About 1,300 of the firm's 3,100 employees will be at the new location—the company's first non-Philadelphia plant.

Facilities will be provided for the manufacture of Micromax and Speedomax recorders and controllers. Space is also planned for load frequency control, as well as for supporting units engaged in engineering, industrial engineering, inspection and shipping.

ILLCO-WAY ion Change

daily serving the outstanding plants of American industry

Ferric iron removed from hydrochloric acid

Illco-Way laboratory develops economical process to remove ferric iron from hydrochloric acid by ionXchange. Only water needed to regenerate resin.

Removal of ferric iron from hydrochloric acid by ionXchange is both economical and commercially feasible.

The method, developed in Illco-Way's laboratory during recent studies of solution purification, involves passage of the acid through a tank properly lined and containing ion-Xchange resin.

The process is interesting, especially from the standpoint of economy, since only water is used to regenerate the resin. The only costs involved are for resin amortization and slight acid losses.

In developing the process, Illco-Way technicians recognized that the usual iron contamination in hydrochloric acid existed as a complex anion (FeCl₄). The problem was to find a suitable anion exchange treatment for commercial operation. After many trials in the laboratory, treatment was discovered. After treatment, the acid is waterwhite, its iron content less than 0.1 ppm. If ferrous iron exists, free chlorine can be used to oxidize the ferrous iron to the ferric state. Any chlorine residuals will be removed by the resin. Sulfates or sulphuric acid are not removed by the chloride form of the anion exchange resin.

As a result of these studies in the laboratory, ionXchange equipment has been developed for plant scale operations by hydrochloric acid manufacturers. Illco-Way, with its wide experience in the industrial field and its long background of ionXchange pioneering, is uniquely

ECONOMICAL PROCESS

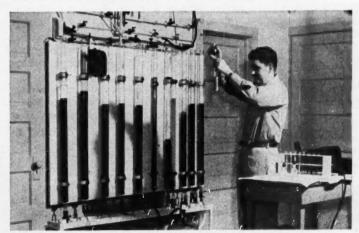
Treatment for complete removal of iron from hydrochloric acid costs only 6¢ per thousand gallons for resin amortization. (Loss in acid is approximately 3 gallons per thousand gallons treated.)

These costs are for a typical technical grade (18-22° Be') hydrochloric acid containing 100 parts per million iron. If the iron content is less than this, costs will decrease proportionately.

equipped to work out the development of a problem from pilot plant to actual process stage. Write for full description of methods, equipment, and installations.

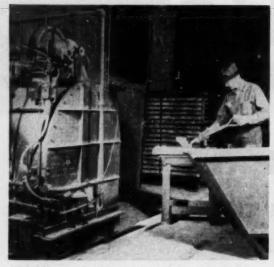


ionXchange

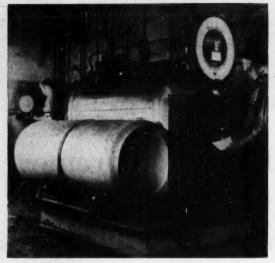


PURIFICATION STUDIED IN ILLCO-WAY LABORATORY

Investigation of solutions requiring purification is carried on in a completely equipped ionXchange laboratory. It is maintained by the Illinois Water Treatment Company for study of process problems on a laboratory to pilot plant to process basis.



Dithiodibenzoic acid must be dried for esterification.



Chlorine addition is from these weighed cylinders.

No Byproducts in New Saccharin Process

Producer has option of making extra amounts of intermediates for direct sale. Route avoids all isomer separations.

Can a new eight-step synthesis compete on a commercial basis with the older four-step (Remsen-Fahlberg) process? "Yes," says Maumee Chemical Co. of Toledo, Ohio. And here's why:

The sale of saccharin alone can sustain profitable operations. There are no byproducts that must be disposed of. In addition phthalimide, anthranilic acid, dithiodibenzoic acid and its methyl ester represent additional areas for commercial development.

Certainly the process is novel. Three patents have already been issued and assigned to Maumee (method for making phthalimide; anthranilic acid; ortho-sulfonyl chloride benzoic acid ester). A fourth process patent will issue shortly.

► An Unusual Company—Commercial production of an established trade item such as saccharin suggests a large company behind it. But Mannee is a small company. It was started as the Mannee Development Co. late in 1946.

During the early stages, the research staff held other jobs and carried out the laboratory work on their own time. One of the owners handled company business during the day and taught evening classes at the University of Toledo to support himself.

In 1949 and 1950, the manufacture of phthalimide and the sale of an improved grade of anthranilic acid

financed research on the saccharin end of the process. Pilot plant quantities were approved by several pharmaceutical manufacturers and diabetic clinics.

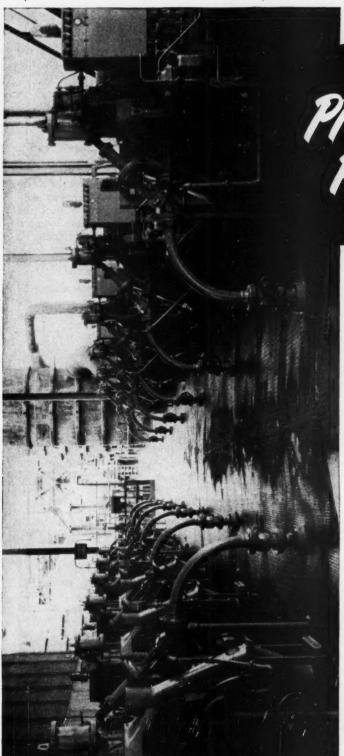
The four buildings of a vacant brewing plant were leased in Nov., 1951 and the installation of the commercial saccharin plant was started. Early in 1953, after many start-up problems had been solved, the operation curve showed profitable performance.

▶ Process Details—Instead of the traditional toluene, Maumee starts with phthalic anhydride. Anhydrous ammonia is sparged up through a reactor containing melted crystals of the anhydride.

The molten mass is kept on temperature with external electrical heating until the absorption of ammonia ceases. Below the reactor, a quench tank partly filled with water (at room temperature) is kept in readiness, agitator turned on. When the melting point of the reaction mass checks with that of pure . . .

the contents of the reactor are dropped into the tank. This has a pop-corn effect on the phthalimide producing clusters of material in solution.

The wooden quench tank then serves as a reactor as sodium hypochlorite and caustic soda (for the Hoffman reaction) are added. Sodium anthranilate is the



PRODUCTIVE REASONS why

> SHARPLES SUPER-D-HYDRATORS

> > mean

low cost

PRODUCTION

of

DRY CRYSTALS

This battery of twelve C-27 Super-D-Hydrators installed in one of the world's most modern caustic plants, is handling the difficult job of separating sodium chloride from caustic liquor. High efficiency rinsing and drying are primary requisites in this operation.

SHARPLES

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WHAT'S HAPPENING . . .

product and acidulation with H₂SO₄ gives the next major intermediate . . .

It is important to add the entire charge of hypochlorite and caustic as quickly as possible, say within 60 sec. There is about a 90 sec. induction period for the Hoffman reaction and then the temperature jumps at least 100 deg. F.

The anthranilic acid must be filtered through carbon black and filter aid since any remaining traces of sodium phthalimide are insoluble in acid solution.

Anthranitic acid is diazotized by adding sodium nitrite and sulfuric acid at 32 deg. F. Ice can be added directly to the stirred wooden reactor to hold the low temperature. The intermediate product is the acid solution of . . .

Next sodium sulfide is added and the dithio bond is substituted for the diazo linkage. The coupling reaction resulting in . . .

The excess sulfur must be removed. A stone filter with a stainless steel shell is used. By adding acid to the filtrate (in a stainless steel tank) a very fine precipitate of . . .

is formed. The fine precipitate is collected in basket centrifuges and then dried for esterification.

Actually the desired form of the dithiodibenzoic acid is the chlorinated derivative. But the benzoic acid groups must be protected by esterifying them prior to chlorination. And this in turn means that the acid must be dried first.

Esterification with methanol is carried out in a 500 gal. glass-lined reactor to give the . . .

A 2,000 gal. glass-lined reactor is used for the chlorination step. The plant chlorine supply is rather interesting. One-ton cylinders are delivered by truck and stored in a specially constructed room on the first floor. By keeping the room temperature at about 100 deg. F., chlorine can be delivered by pipeline to the weigh-cylinder on the fourth floor without any auxiliary equipment.

Chlorination is carried out at low temperature by circulation of refrigerated brine through coils in the reactor. Oxidation occurs simultaneously with the chlorine addition resulting in . . .

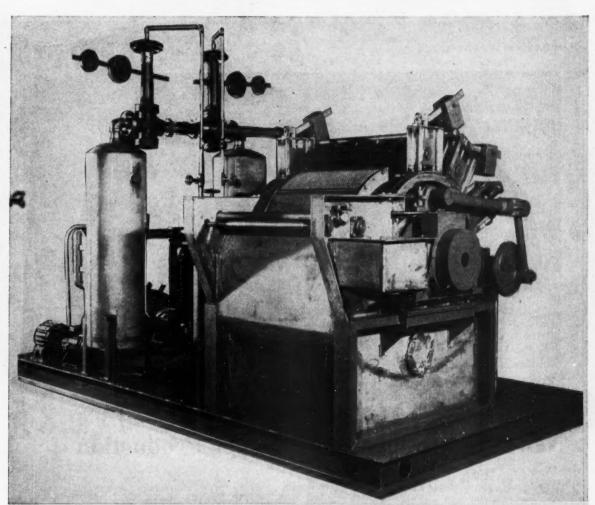
Then the addition of ammonia completes the synthesis by forming an ammoniacal solution of crude . . .

This solution is then pumped to the "white" area of the plant. Since saccharin's main use is in pharmaceutical manufacture, special care is taken to avoid contamination of the finished product. All the air entering this section of the plant is filtered and carbon treated. Humidity is closely controlled. Only white paint is used and they even had to put in plaster walls.

Several Forms Available—By slightly varying the precipitation, crystallization and drying procedures, Maumee produces saccharin in several forms: insoluble powder; sodium saccharin as soluble powder, soluble granular, or insoluble granular; and the calcium saccharin derivative.

Equipment for these finishing steps includes three stainless steel tanks and one lined with Teflon (acid saccharin presents some corrosion problems), filter press, Fitzpatrick mill and a small rotary kiln.

▶ Intermediates for Sale—Commercial development of the intermediate products in this synthesis is a goal towards which Maumee is aiming. For more information about these products, turn to page 150.



HIGH SUBMERGENCE STRING DISCHARGE CONTINUOUS VACUUM FILTERS

Industries using standard design drum and disc type continuous vacuum filters are often interested in a specialized Eimco filter to develop a new product, increase production or complete a research project.

Such was the case of the customer who ordered the machine shown above. It is a high submergence (55%) stainless steel drum type filter equipped with compression rolls, string discharge and wash headers.

This unit uses Eimco "pin" type agitator and the vacuum line is equipped with vacuum regulating valves. All necessary operating equipment including receivers, motors, pumps, etc., are mounted in standard Eimco package arrangement on a fabricated steel sub-base with piping in place and wiring to a control panel.

Call an Eimco Engineer and let him help you solve your filtration problems (no obligation to you). Eimco has been serving the processing industries for more than half a century.

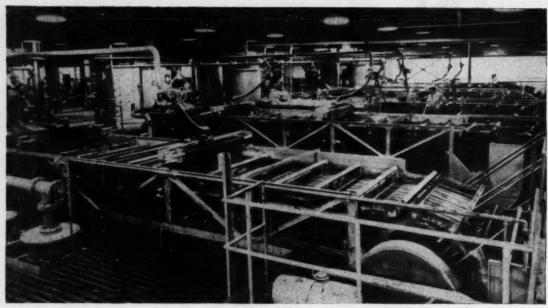
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You Can't Beat An Eimco





TRAVELING pan filters separate gypsum from phosphoric acid, as Davison's . . .

New Plant Swells Triple Super Production

Phosphate operations in Florida have reached a new high with the recent start-up of Davison Chemical Corp.'s \$10-million concentrated superphosphate plant at Bartow.

When the new plant reaches its rated capacity of 200,000 tons per year, according to Davison, the company will be the second largest producer of "triple super." Davison's production will be added to a current industry output of approximately one million tons a year, of which nearly 80 percent is made in Florida. By the end of this year total demand will reach 1.6 million tons, predicts the U. S. Department of Agriculture.

New Pan Filter—Davison is the first in this country to use the Dorr-Oliver pan filter for separating waste gypsum from phosphoric acid. As shown above, this filter consists of an endless series of individual pans operating after the fashion of an apron conveyor.

Provided by the Dorr Co.—who designed the Davison plant—the

filter was originally designed by Mario Giorgini, manager of Dorr-Oliver's subsidiary in Milan, Italy. Davison's five machines, each about 5 ft. wide and 40 ft. long, were built in Italy, using the European equivalent of Type 316 stainless steel. Five others are in operation in Europe, and Dorr reports that two more installations are under construction, one in the U. S., the other in Japan.

Dorr-Oliver developed this filter especially for phosphoric acid service. It provides good countercurrent washing of the cake and especially thorough washing of the cloth to prevent scaling and blinding. Cloth washing is done while the pans are upside down on the return run.

Functionally, this filter is much like the Prayon filter described in Chemical Engineering last month (pages 128 and 296). With the Prayon, the pans follow a horizontal circular path instead of a straight-line path.

▶ Other Highlights—The new plant

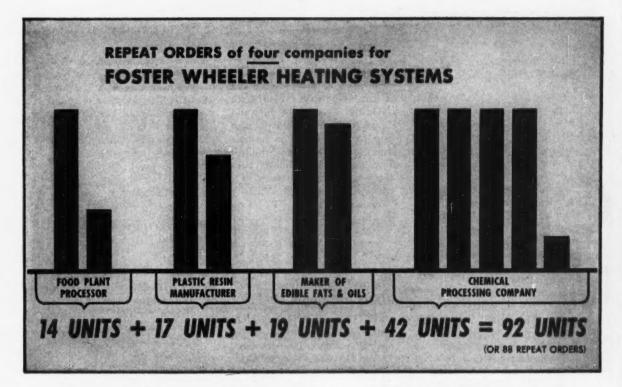
incorporates several other noteworthy features:

• Its sulfuric acid unit, designed by Monsanto Chemical Co., has a rated capacity of 550 tons of 100-percent acid a day. Monsanto says it's the largest contact plant in operation. Heat developed here is used to power much of the equipment of the triple plant.

• Davison is using lower-grade phosphate rock than usual but can still make 32-33 percent P_sO_s phosphoric acid. Rock usually runs 72-74 percent BPL; Davison's analyzes 66-68 percent. Credit, says Dorr, goes to its patented "strong acid" process which recycles acid slurry within the leach system.

• Phosphoric acid is concentrated to 38-40 percent P₂O₈ in three single-effect vacuum evaporators each 15 ft. high and 6½ ft. in diameter. Evaporator bodies are lined with rubber and tubes are made of impervious graphite.

 Acid and raw rock yield dry, closely sized and cured granules on a continuous basis.



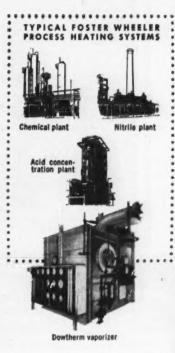
A Story of Satisfaction-retold 88 times

Ever-growing volume of repeat orders for Foster Wheeler high-temperature low-pressure heating systems your best assurance of FW's specialized knowledge to solve critical processing problems.

IN the design of specialized process equipment, nothing can take the place of experience. For in no other way can the vast technical knowledge -so essential to success-be obtained.

This holds particularly true of hightemperature low-pressure heating systems for improving product quality at lower cost. Here, the importance of Foster Wheeler's twenty-one years' experience in designing over 450 Dowtherm units totalling more than 1,500,000,000 Btu per hr cannot be overemphasized. These vary from the smallest (44,500 Btu per hr at 700F and 88 psi) to the largest (45,000,000 Btu per hr at 700F and 88 psi).

The satisfactory operation of the four different Foster Wheeler installations charted above - and the eightyeight repeat orders that followed establishes a record in successful processing performance that speaks for itself! For information, write Foster Wheeler Corp., 165 Broadway, New York 6, N. Y.





FOSTER M WHEELER

Three Firms Plan More Cellophane

Demand for cellophane doubled in the past ten years, largely because of the increasing use of self-service merchandising. And producers of the product are expanding their facilities to keep up.

By fall of this year, E. I. du Pont de Nemours & Co. will have completed expansion of its existing plants (Richmond, Calif., and Clinton, Ohio) to boost potential output by 25 million pounds a year. At the same time, engineering work is proceeding on other modernization projects that will up cellophane capacity even more in 1955.

And at Kern, Ind., Olin Mathieson Chemical Corp. plans a big new cellophane plant to produce 33 million pounds per year. No start-

ing date has been named as yet, but engineering is under-way. Another plant, of undetermined size, is scheduled for Red Bluff, Calif.

On the other side of the world, British Cellophane, Ltd., is planning to build a plant in Australia at a cost of about \$6.75 million. Construction will probably not begin for at least two years. The company, through its subsidiary, Australia Cellophane PTY., Ltd., is a major importer of transparent cellulose film into Australia—approximately 4 million pounds annually.

Major Expansion Starts for Union Oil

A \$15-20 million program to increase gasoline production and prevent air pollution is under-way at Union Oil Co.'s Oleum, Calif.,

refinery. Projects include construction of a Unifiner for desulfurizing raw gasoline streams, a Platformer for reforming desulfurized gasoline and supplementary treating and gas scrubbing facilities.

Construction started in mid-April with completion slated for early next year. Bechtel Corp., C. F. Braun and Fluor Corp. have the construction contracts.

Big Oversubscription On New Nitrogen Goal

The last applications for fast tax write-offs to bring the nation's nitrogen capacity up to defense goals have been reviewed and submitted to the Office of Defense Mobilization by the Business and Defense Services Administration. Covering about 250,000 tons of new annual capacity, the recommendations represent only about one-half of the 30 applications received.

Originally, only 163,000 tons of additional nitrogen capacity were needed to meet ODM's goal of 3.5 million tons a year. Then Monsanto Chemical Co. turned back a previously approved project for 84,000 tons, bringing the balance required to 247,000 tons.

BDSA also sent recommendations covering a number of existing facilities for which certificates of necessity had been denied under the old goal. Total applications screened by the government agency represented 900,000 tons.

Koppers Picks Polyethylene Plant Site

Port Arthur, Tex., will be the location of the new polyethylene plant of the Koppers Co., Inc., Pittsburgh. Plans for this major expansion into another plastics field were announced earlier (Chem. Eng., March 1954, p. 112) before the plant site was determined.

Koppers will buy ethylene gas from new ethylene facilities being constructed at the near-by refinery of Gulf Oil Corp. Production will be pelletized polyethylene for sale to injection molders and extruders.



Sulfur Production Begins on Pacific Coast

The first commercial output of sulfur on the West Coast began recently when Texas International Sulphur Co. opened its new plant at San Felipe, Baja California, Mexico. It is the only one on this continent now producing sulfur from surface ore. Initial output is 700 tons a month, but all facilities are designed

for easy expansion to twice that capacity.

Company president Victor Dykes (above, left) has also revealed that TIS has begun core drilling for sulfur in Tehuantepec, Mexico. Three other firms have already found important high grade sulfur deposits in that area.

simplicity and sustained efficiency in dust filtering and collection...



Dualaire

REVERSE-JET DUST COLLECTOR

Efficiencies up to 99.99%

Cloth filter systems of one design or another have long been used by industry for cleaning industrial gases and/or recovering dust or other suspensions. But three prob-

lems are common to such systems...(1) Extreme changes in pressure drop and filtering efficiency as dust cakes accumulate on the filter surface...(2) Wide pressure fluctuations and surges in the plant system as filter units become clogged or are cut out and rapped for cleaning...and (3) Rapid deterioration of the filter material by the vibration, shaking and rapping equipment used for cleaning.

But now the DUALAIRE Collector—as engineered by Western Precipitation, pioneers in the field of dust recovery—provides the answer to these and other problems common to conventional bag-house equipment.

The Dualaise Principle is Simple. Efficient. Basically, each Dualaire filter unit consists of a cloth or felt tube, open at both the top and bottom. (A) Dust-laden gases enter at top of the tube and are filtered as they pass through the side walls of the tube to the exhaust system. (B) Dust particles collect on the inside of the tube and before the cake builds up sufficiently to affect filter operation, a tubular blow ring (C) automatically starts moving up and down the outside of the filter cylinder. A jet of air, concentrated by this blow ring, reverses the normal gas flow at the point contacted by the ring, thus jetting the dust layer off of the inner surface of the filter tube.

This jetting action is further assisted by a flexing of the filter cylinder as the blow ring passes, thus cracking and loosening the dust layer frem the inner surface, from where it drops to the recovery chamber below the bottom of the tube.

The entire operation is positive and simple. The blow ring starts its action automatically as soon as the dust layer causes a pre-determined pressure differential. And after the filter surface is cleaned, the blow ring automatically stops.

6 ADVANTAGES OF DUALAIRE DESIGN...

PRESSURE DROP remains uniformly low at all times because the dust is removed continuously in small

FILTERING EFFICIENCY remains uniformly high at all times without the "choking" action characteristic of conventional bag-houses. Actual field tests show efficiencies as high as 99,99%!

<u>DUST RECOVERY</u> is in steady increments — not in sudden large "batches" as with conventional rapping systems. Thus the Dualaire eliminates surges and detrimental variations in the plant system.

FILTER ELEMENT has a much longer life because it is not subjected to

the stresses of rapping or jarring while being cleaned. Dualaire reverse-jet cleaning action is gentle, yet far more effective.

OREAT SAVINGS are also made in space and the size of installation required. Because each Dualaire filter unit is cleaned more-riess constantly without shut-down, there is no need for costly standby units — or the complicated switching equipment to aut standby equipment in and out.

BASIC UNITS are "sectionalized" and are available in 5 standard heights. Sections can be boiled together in any desired multiple, providing a capacity runge to fit virtually any requirement. As needs increase, add mere sections.



There are many other advantages built into the DUALAIRE. For further details send for this descriptive 12 page booklet. Or contact your nearest Western Precipitation representative!

* B "Dualaire" & "Multiclone"



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Fertilizer Prescriptions Filled Here

In Florida there are over 500 formulations which a manufacturer may be called upon to supply. Naco has a new engineering solution to this complex problem.

Labor is a costly ingredient in a fertilizer batch. That's why Naco Fertilizer Co. has emphasized mechanization in its new batching and mixing plant at Ft. Pierce, Fla. By using pushbutton batching methods, reversible shuttle conveyors, printed weight records and automatic bagging scales, man-hours are kept to a minimum.

These built-in features allow Naco to turn out over 500 different formulations during the 10-month season. The unusually large number of mixtures is peculiar to soil conditions in Florida. In some other states, the agricultural stations have approved only a relatively small number of fertilizer mixes to meet all soil requirements. Indi-

ana, for example, uses about a dozen standard mixtures. Florida has over 500 registered standards and Naco fills requests for any of them.

▶ Engineering Design—This type of plant is a big engineering order. Prime contractor was The A. J. Sackett & Sons Co., Baltimore, who designed, constructed and equipped the plant. Here are some of the novel design features aimed at labor and production economy:

Two receiving conveyor systems allow raw materials to be received at the same time that other materials move along the manufacturing line. To avoid double handling, railroad cars can serve as storage bins while their contents

are emptied directly into the production hoppers. (In many older plants receiving is scheduled on one shift and manufacturing on another at premium wages. Naco's operating flexibility eliminates this.)

•Tractor shovels are used throughout for moving bulk materials. Shovel operators receive their instructions (through a system of colored light panels) from the binselector operator. He guides filling funnels, called bin selectors, located above the conical hoppers.

• Dual bin selectors above each hopper can guide two materials into any of the eight compartments of the hopper. If one material makes up a large part of the total mix, then two or more of the compartments can be filled with it. This permits its withdrawal through two or more weigh valves, cutting down on batch weighing time and labor.

• The bulk-scale-and-mixer op-

NEW Century

Performance-Rated® INTEGRAL H.P. MOTORS



Now available in 1...1½...2 H.P. sizes— NEMA frames 182 and 184.

Improved Motors

to match your needs

SMALLER - LIGHTER

More uniform silicon-laminated steel; thinner, tougher "Mylar" slot insulation — just two of the many technical developments that help make these new Century Performance Rated Motors so much smaller and lighter.

BETTER PROTECTION

New concepts of internal motor ventilation permit end bracket and frame design that gives far better protection from falling liquids and solids...still maintain 40°C. temperature rise.

MORE FLEXIBLE MOUNTING

You can even have cushion mounting with these new Century Integral H.P. Motors — your choice of sleeve or ball bearings. Ball bearing motors mount vertically, upside down, in any position. End brackets can be rotated for top protection in any position.

EVEN MORE DEPENDABILITY

Improved plastic impregnating varnish and plastic insulated magnet wire provide unusual resistance to abrasion, moisture and heat. These new materials possess far better dielectric qualities. Die cast aluminum rotors are individually, dynamically balanced to assure freedom from vibration.



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in Principal Cities

Call Your Century Application Engineer...

Ask him about the new Century Performance Rated Integral and Fractional H.P. Motors.

CENTURY ELECTRIC COMPANY . 1806 Pine Street . St. Louis 3, Missouri



In the top . . .



Out the bottom . .

crator weighs out each ingredient, according to the formula required, by turning pneumatic controllers on the console in front of him. He has three conical hoppers, each divided into eight sections, to choose from. Flow is controlled by weigh valves (air-operated sliding doors) at the bottom of each hopper compartment. The valves can be left in the full-open position at the beginning of the batch; and then moved to the "dribble" position for final adjustments.

• Automatic dial scales and printed tape records provide management with a positive check and a permanent record of what actually goes into each fertilizer "prescription".

• With a weighing cycle of less than five minutes for an 8,000 lb. batch, maximum production rate can be maintained at 50 tons per hr.

• At the touch of another lever on the control console, the batch moves to the Sackett Gravity Mixer and then to a vibrating screen. The classified materials are fed to Richardson automatic bagging scales for packaging.

► Saves Material Too—In addition to labor economy and production flexibility, Naco can be expected to save on the cost of ingredients also. Here's why:

State agricultural agents may sample and analyze the chemical

content of a fertilizer mixture at any time between the packaging of the product and the actual application of the fertilizer in the field. All manufacturers are required to guarantee the analysis to be as represented and many of them deliberately over-fortify their mixtures. This avoids penalties for shortages caused in hand-mixing and weighing operations. With printed tape records of exact ingredient proportions, the new plant can confidently use a lower safety factor in guaranteeing nitrogen, phosphoric acid and potassium values.

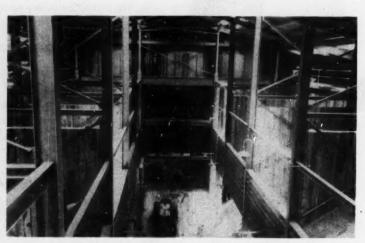
▶ Separate Base Line—Preparation of fertilizer bases at Ft. Pierce is entirely separate from the manufacturing and shipping lines. A fourth multiple hopper is incorporated into the basing line for the batching of raw materials. Again, the printed tape method is used to assure accurate proportions.

A two-ton rotary mixer and a system for adding ahydrous ammonia and nitrogen solutions are available to prepare the bases for curing. Since ammoniation operations give rise to high temperatures, the bases are dropped through a vertical flash cooler before they are conveyed to the curing bins.

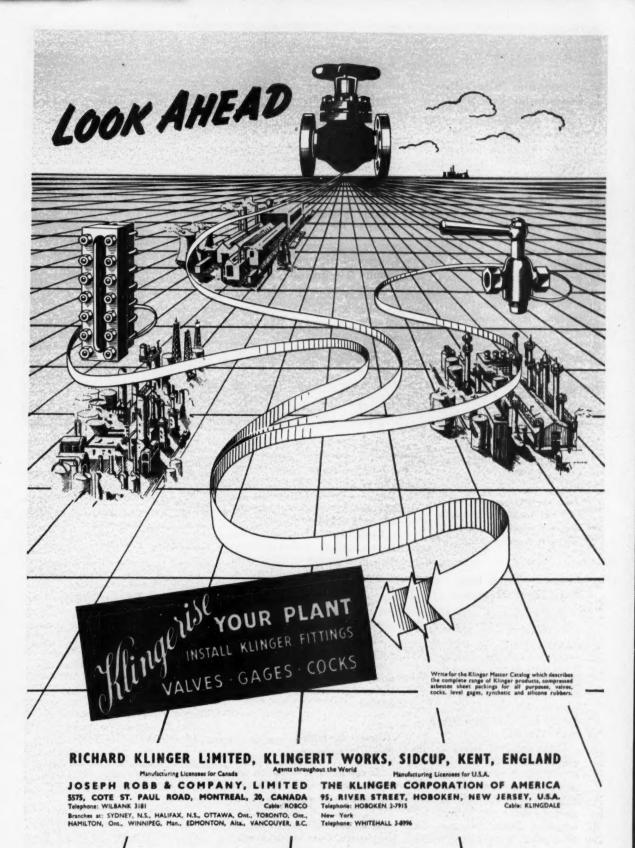
The plant's storage and curing bins (28 of them now) provide storage for 7,000 bulk tons. But both ends of the building have been left clear for expected expansion.



And mix thoroughly



From storage, materials move to and from three conical batching hoppers.



Ammonium Nitrate Plants Use Similar Processes

Two new fertilizer plants—in Louisiana and Missouri—will make pelleted ammonium nitrate by the same process and expect similar percentage yields. Both start with ammonia from natural gas.

• At its \$31 million Barton plant just north of New Orleans, La., the Lion Oil Co. is now producing 300 tons of anhydrous ammonia per day. Part of this is converted to nitric acid which is then reacted with more ammonia to make 550 tons per day of ammonium nitrate. The 50 tons of ammonia not required for this process will be sold. Natural gas required is 20 million cu. ft. per day.

• The other company—Mississippi River Fuel Corp.—is planning a \$15 million plant at Crystal City, Mo. It will be the first petrochemical plant in the St. Louis area. Starting with 10-12 million cu. ft. of natural gas a day, the proposed unit will turn out 200 tons of anhydrous ammonia daily. Half of this will be marketed as such, the rest converted to nitric acid and thence to 230 tons per day of ammonium nitrate. Completion is expected in late 1955.

Crane to Jump Into Rare Earth Markets

With \$40 million earmarked for development of three new mineral deposits during the next three years, the Crane Co., Chicago, Ill., is preparing to separate, purify and aggressively sell rare earths. Location of the deposits has not yet been revealed, but best guesses are Florida, Idaho and either Washington or Oregon.

Crane will both mine the ore and separate components. Ilmenite and rutile will go into production of titanium. Recovered zircon will be used to make a patented tanning agent for which the company has secured a license. Monazite, the other major ore constituent, will be separated into its rare earth components by a process developed by the Societe de Terre Rares, a subsidiary of Pechinery, S. A., of France.

The company claims this method is far superior to that used by Lindsay Chemical Co., West Chicago, Ill., since it gives purer fractions. Total ore to be processed is still uncertain, but is expected to exceed 2,000 tons a year. Thorium produced will be purchased by the U. S. government.

Chemical Milling Forms Aluminum Parts

Precision milling of aluminum from sheets and forging stock can now be accomplished by immersion in chemical solutions. Called Chem-Mill, the process was originated by North American Aviation, Inc., and Turco Products, Inc., both of Los Angeles, Calif.

To prepare a part for chemical milling, the metal to be removed is left exposed, while the rest is masked with a specially developed coating. The entire part is then submerged in the Turco etching solution which attacks exposed surfaces evenly and at a constant rate until the desired amount of metal has been etched away.

Electronically controlled, the process produces finished metal surfaces to accuracies of 0.002 of an inch. Costly milling machinery is eliminated and, with a large enough tank, any number of parts can be etched at the same time, greatly reducing unit costs.

Most of the experimental work with the Chem-Mill process has been on aluminum. But application to such metals as steel, stainless steel and titanium is now being studied.

Texaco to Build Six Platformers

As part of its \$275 million capital expenditures program this year, the Texas Co. is putting in six new Platforming units with total rated capacity of 75,000 barrels per day. In addition, three alkylation units, a hydrotreater and an isomerization unit will be built.

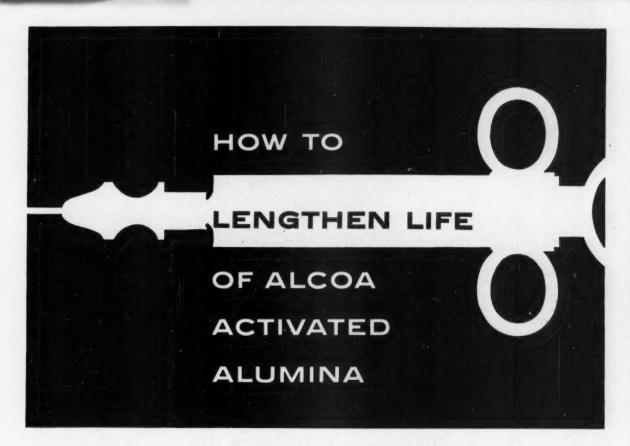
Six of the company's refineries are involved, as follows:

- Port Arthur, Tex.—Construction started in April on a second 20,000 bpd. Platformer. Refinery's first such unit is scheduled for completion early this summer.
- Westville, N. J.-Work began last month on a 12,000 bpd. Platformer and a 1,926 bpd. alkylation unit.
- Wilmington, Calif.—Planning a 10,000 bpd. Platformer, 10,000 bpd. hydrotreater and a 1,000 bpd. isomerization unit.
- Lockport, Ill.—An 11,000 bpd. Platformer and a 1,000 bpd. alkylation unit are scheduled to be started this summer.
- Lawrenceville, Ill.—Construction has begun on a 13,000 bpd. Platformer and a 2,250 bpd. alkylation unit.
- Tulsa, Okla.—Ground will be broken in a few months for a 9,000 bpd. Platformer.

In addition, complete modernization and expansion programs are being carried out at the company's El Paso and Amarillo, Tex., refineries. These should be completed this fall.

Convention Calendar

- American Institute of Chemical Engineers, special symposium on nuclear energy, including exposition of "Atoms for Peace." University of Michigan, Ann Arbor, Mich., June 20-25.
- Western Plant Maintenance Show, including engineer-management conferences on maintenance problems, Pan Pacific Auditorium, Los Angeles, Calif., July 13-15.
- Western Packaging & Materials Handling Exposition, Civic Auditorium, San Francisco, Calif., August 17-19.
- American Institute of Chemical Engineers, national meeting, Hotel Colorado, Glenwood Springs, Colo., Sept. 12-16.
- First International Instrument Congress and Exposition, including many technical sessions, Philadelphia Museum and Convention Hall, Philadelphia, Pa., Sept. 13-25.



ALCOA Activated[®] Alumina, the "old reliable" among desiccants, is used to dry everything from furnace atmosphere to wind tunnel "air" and commercial gases. Nearly all of these users obtain longer service life than has been obtained in drying high-pressure natural gas. Here are some hints that will increase the effective life of Activated Alumina in drying natural gas, L.P.G., and petroleum products.

1. Remove Contaminants

After long periods of continued use, dust, fines or any water-soluble impurities such as salt, which may have accumulated, should be hosed out with water. Activated Alumina is completely resistant to action of liquid water. It can be reactivated and immersed again and again without shattering.

Use a precontactor or extractor containing discarded Activated Alumina to remove contaminating material.

Cooling action by shell-and-tube condensing units will coalesce the absorption and compressor oil from vapor phase, reduce much of the oil and reduce water content of the gas.

Avoid caustic carryover. Use a mist extractor to remove caustic spray.

In handling any natural gas, including underground storage, keep it free of oxygen so that it can be dehydrated without danger of deposition of sulphur.

2. Avoid Mechanical Damage

Operating desiccant beds above rated capacity may result in excessive through-put causing turbulence inside dehydrator, blowing a deep crater in top of bed and pulverizing the desiccant. Use a baffle plate to avoid this. If upward flow lifts and abrades entire bed, completely fill top space with ALCOA Tabular Alumina Balls.

Design dehydrators to minimize mechanical vibration to prevent desiccant abrasion.

Release pressure in such a way that gas will pass downward, slowly, through bed.

If screen or support grate fails, use ALCOA Tabular Alumina Balls in layers of properly graded sizes, with small grate supporting largest balls around exit opening.

3. Reactivate Properly

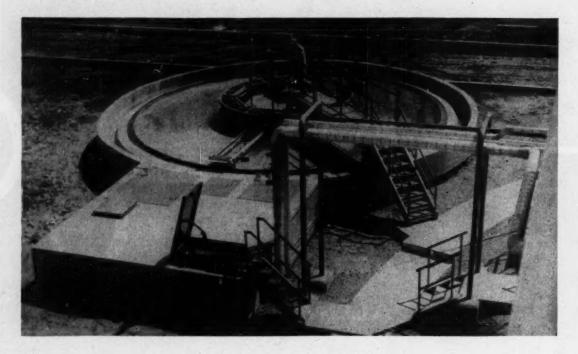
ALCOA Activated Alumina should be reactivated to a minimum temperature of 350° F. Lower temperatures cause heavy fractions and water to linger, reduce adsorptive capacity.

Reactivate promptly after use. Reactivation gas flow should be in the opposite direction from dehydration flow. Liquid trapping should be eliminated. Reactivation by live steam is generally harmful to all solid desiccants and should be avoided.

These hints should help you increase the service life of ALCOA Activated Alumina. For complete details, or answers to your specific drying problems, write to ALUMINUM COMPANY OF AMERICA, CHEMICALS DIVISION, 702-G Alcoa Building, Pittsburgh 19, Pennsylvania.



ALUMINUM COMPANY OF AMERICA



New Waste Treatment Plant Kills Cyanides

Oxidation of cyanides with hypochlorite; precipitation of heavy metals with lime—key steps in this highly successful waste disposal plant.

After touring the new \$1-million waste-treatment plant of Oneida, Ltd.,* an official of the N. Y. State Pollution Control Board, commented:

"This is one of the few major waste treatment plants in the U.S. that licks a disposal problem 100 percent."

He had good reason for making that statement. Handling 20,000 gal. per hr. of complex plating wastes, the Sherrill, N. Y., plant delivers a clear, effluent—completely harmless to aquatic life—into a small stream.

The highly instrumented, combination batch-continuous chemical process incorporates the latest techniques for treating alkaline and acid wastes, containing oils, cyanides and dissolved metals. The result of a comprehensive chemical and engineering study by three groups (Oneida, Yale University and Westcott & Mapes), it involves no biological treatment.

Success of the process centers around proper utilization of pH conditions—and automatic control of these conditions. Cvanides are oxidized with sodium hypochlorite; metal hydroxides are precipitated and settled out; all at the correct pH. And they get the correct pH by mixing alkaline and acid wastes, or by adding lime:

pH of 10.5. At this pH, cyanides are rapidly oxidized to cyanate with a sodium hypochlorite solution.

• pH of 6.5. At this condition cyanates rapidly oxidize to CO_z and N_z .

 pH of 3. Metals (Cu, Ni, Zn) dissolve; oils float to the surface and are continuously skimmed off.

• pH of 8.5. Metals precipitate as hydroxides. After thickening, the sludge is removed and the overflow is filtered through sand filters.

▶ Permanent Solution—The wastes from Oneida's pickling, cleaning and plating operations were previously routed to retaining lagoons. At best, this was only a temporary solution, since you can't go on building lagoons indefinitely. Now, waters are assembled in three compartments of a collection sump—one compartment for alkaline waste, the second for acid wastes and the third for silver-bearing cyanides.

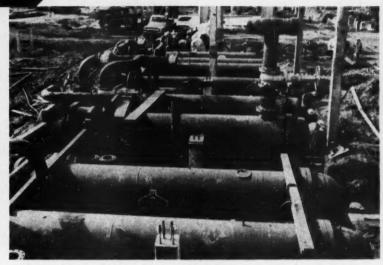
Alkaline wastes (caustic potash, soap, oils, and metal cyanides) are pumped to an agitated rubber-lined pH adjustment tank. Either limeslurry or acid waste is added to bring the alkaline material to a pH of 10.5. The rate of addition of the fluid streams are controlled by a pneumatic pH controller.

[•] Who makes Community Silver Plate tableware.

delivered on time

...163 miles of tubes





78 SWECO heat exchangers handle 800,525,000 BTU/HR of heat transfer in new Ferndale Refinery

All the tubular heat exchangers for the mammoth new 35,000 barrels-per-day General Petroleum Corporation refinery at Ferndale, Wash., were engineered, fabricated and delivered on time by Southwestern Engineering Company, in precise co-ordination with field construction schedules.

Major savings in time and money resulted from having all heatexchangers engineered and maufactured by sweco.

Within 10 days from order, sweco engineers began issuing drawings of the heat exchanger units, which speeded up the engineering of piping, foundations, space and structural requirements. All sweco engineering drawings were completed in less than 2 months.

Within 7 months sweco shops had delivered all 78 heat exchangers, including those fabricated from special alloy materials. Coordinated engineering, one-point purchasing, one-point inspection—plus sweco's rigid expediting to fit delivery schedules exactly—saved weeks of time.

Mass production of similar units...interchangeability of parts...lower inventory requirements in spare tube bundles...saved an estimated 7½ to 8% of total heat exchanger cost.

sweco offers this kind of efficient, high-speed engineering and manufacturing service . . . regardless of size of job. For new process plants and equipment . . . or rebuilding, repairing, or enlarging existing plants . . . it will pay you to consult sweco.

181,700 Sq. Ft, of tube area (163 linear miles of tube) is required to provide heat transfer capacity of 800,525,000 BTU/HR at the new General Petroleum refinery at Ferndale, Washington, a modern full-scale petroleum processing plant in the Pacific Northwest. The heat exchangers for crude oil distillation, thermofor catalytic cracking, catalytic reforming, polymerization, and related units, all custom engineered and manufactured by SWECO, have the heat transfer equivalent of 235,000 kw or 315,000 hp. Engineer and constructor: Bechtel Corporation.



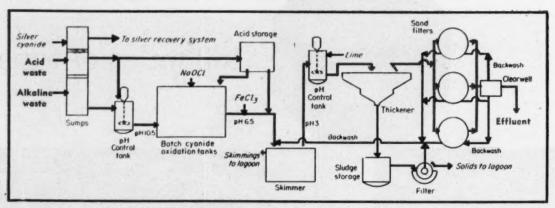
SOUTHWESTERN ENGINEERING COMPANY

Engineers and Constructors

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SWECO PRODUCTS

Heat Exchangers
Custom fabrication of
all types of steel and
special alloy vessels for
the process industries.
Screen Separators.



OXIDATION, NEUTRALIZATION, SETTLING, FILTRATION-key steps in Oncida's waste treatment process.

▶ Cyanide Oxidation—From the adjustment tank, the alkaline waste goes to any of three 80,000 gal. cyanide oxidation tanks. Batch treatment was chosen here because of the varying amounts of cyanides in the waste stream. The batch arrangement permits treatment of a composite. Filling and emptying cycles of the three oxidation tanks are fully automatic.

A sample is taken, analyzed for cyanide and cyanate, and total NaOCl dosage calculated for a 15-percent solution. The NaOCl is added in a steady stream, with agitation. At the pH of 10.5 oxidation of cyanide to cyanate takes place rapidly.

After 10 min. of agitation, and after all NaOCl has been added, the pH is lowered to 6.5-7 with waste pumped from the acid tank.

At 6.5-7, conversion of cynates to CO_s and N_s takes place in about 15 min. A sample is again taken, and checked for cyanides or chlorine excess. Depending on the results, excess chlorine is destroyed or the oxidation step is repeated to further reduce the cyanide content.

An interlocking valve arrangement on the oxidation tanks prevents any untreated tank from being drained—and a draining tank cannot receive raw waste.

Skimming—Flow of material, after the batch oxidation, is contin-

Treated, oxidized wastes, mix in a pipeline mixer with acid waste and a 20 percent ferric chloride solution. The acid brings the pH down to 3, and ferric chloride helps to form a dense floc, during settling. At a pH of 3, most of the metals go into solution. But oil emulsions are broken and soaps form fatty acids. The oils float to the surface and are skimmed off in a 25,000 gal. skimming tank. Retention time in the tank is approximately one hour.

After skimming, the wastes flow to an agitated rubbed-lined pH adjustment tank. Lime slurry is added until the pH comes up to 8.5—bringing out metal hydroxides.

► Thickening—By gravity flow, the slurry is routed to a 35-ft.-dia. thickener—complete with sludge scraper and agitator.

The sludge is continuously removed through a sludge pump to a storage tank. From there, it's filtered on a rotary vacuum filter; the cake discharges to a lagoon and filtrate is recycled.

Filtration—The thickener overflow goes to a sump and from there is sent to three sand filters. Flow over the filters is by gravity.

From the filters, the effluent flows into a 14,000-gal. clearwell.

Backwash water for the filters is drawn from the clearwell—an automatic operation. As solids come out on the sand, pressure builds up. At a predetermined pressure, a switch trips, starting the backwash sequence. Backwash water is collected and reprocessed through the same system as the treated alkali wastes.

► Silver Recovery — Silver-bearing cyanide wastes are treated separately from other wastes in the plant:

They are pumped to one of two concrete 14,000-gal. agitated treatment tanks. The pH is adjusted to 10.5, and sufficient NaOCl added to oxidize cyanide to cyanate. The silver comes as a AgCl. After two hours of agitation, the AgCl is settled out, the supernatant decanted and sent to the alkali sump. Other batches are treated in the same way until the AgCl build-up is large enough to form a thick slurry.

It's then drawn off to a 2,000 gal. acid-proof brick-lined storage tank. After acidification to a pH of 3, AgCl is allowed to settle and the acid layer decanted. The AgCl is washed, filtered, dried and shipped to a refiner for silver credit. The plant recovers over 99 percent of the silver.

The final effluent coming out of the waste treatment plant has about 0.09 ppm. of cyanide, compared with 20 ppm. in the incoming waste. Metals in the final effluent are down in the range of 0.1 ppm.

The effluent flows into Sconondoa Creek, where it's diluted about 10:1.

Everybody—the town of Sherrill; New York State; and Oneida, Ltd.—is happy with the treatment plant. The town, because it eliminates contamination of fishing, boating, swimming and farming areas. N. Y. State, because the plant is a prime example of what must eventually be done with all toxic, polluting, wastes. And Oneida, Ltd., because of its great value for continuing good public relations.



The almost perfect process



Chemical engineers, executives... You can get correct fluid mixing for any process, systematically—with results assured. A new technical film called "Fluid Mixing," in color, shows you how. The 30 minutes you spend seeing it may save you weeks of trial-and-error. For a showing, without obligation, just write to MIXING EQUIPMENT Co., Inc., 128-g Mt. Read Blvd., Rochester 11, N. Y. As you so well know, setting up a new process is rarely easy.

It's all the more disheartening when your process is perfect—except for just *one* step.

In one company's case, the problem was mixing. A hypersensitive product had to be hydrogenated and mixed at high speed in a glass-lined tank. The 500-gallon batch was worth several thousand dollars. And the slightest contamination meant total loss of the batch.

Trial runs with several mixers and shaft seals were fruitless... and made a bright idea look like a costly mistake.

"Enough of this expense," said the processor. "Let's unload this problem on a specialist."

Mixeo engineers went to work on the problem. They came up with a mechanical shaft seal that protects the batch, a mixer that mixes at high speed, with no stress on 'the glass tank lining.

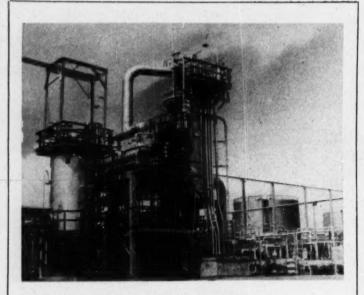
After laboratory proving, the mixer was installed at the customer's plant. Now—nearly two years later—it is still running smoothly.

Not a single batch has been lost—and there has been no mechanical difficulty whatsoever in those two years.

When you plan a process that calls for fluid mixing, contact Mixeo early—get profits started faster.

you can cut cost ... eliminate risk ... get going faster with "Lightnin" Mixers...





Hydrofining Capacity Rising Rapidly

One of 19 Hydrofining units now on stream or under construction, the plant at the Fawley, England, refinery of Esso Petrolcum Co., Ltd., (above) is used to upgrade 1,580 barrels per day of solvent naphtha. Combined capacity of the 19 units will be 155,000 barrels daily. Hydrofining uses a fixed bed reactor to treat hot oil feed (550-800 deg. F.) in the presence of hydrogen and a regenerable metal oxide catalyst. Products treated include gasoline, heating oils, lubricants and waxes, particularly those with high sulfur contents.

Allied Expands Ammonia-Urea Capacity

Two ammonia projects, one just completed, the other just starting, are expected to give the Nitrogen Division of Allied Chemical & Dye Corp. an advantageous marketing position in both the South and the Midwest.

At its Hopewell, Va., plant, Allied will soon install new facilities and change existing equipment so that it can turn out an additional 50,000 tons a year of anhydrous ammonia. Capacity for converting ammonia to nitrogen solutions is also scheduled for a boost.

And just on stream is the company's new \$27.5 million plant at La Platte, Neb., near Omaha. Capacity here is 75,000 tons per year of ammonia. Of this, however, only about 10 percent will be sold

as ammonia. The rest will be converted to 11,000 tons per year of urea—crystals, pebbles, feed mixtures and urea-ammonia solutions.

At La Platte, by-product carbon dioxide from the ammonia synthesis gas is purified, compressed, mixed with anhydrous ammonia and passed through a series of autoclaves to produce urea. Natural gas for the ammonia synthesis is being supplied by Northern Natural Gas Co. of Omaha, Neb., on an interruptible basis.

Soda Sulfite Pulping Reduces Waste Problems

Semi-mill scale tests just completed by Nekoosa-Edwards Paper Co., Port Edwards, Wis., indicate that use of soda-base instead of calcium-base sulfite pulping liquor, followed by recovery of the chemicals from the spent liquor, can be economically feasible. At the same time, because the liquor is not thrown away, stream pollution problems are minimized:

Conventional sulfite processes use limestone as a base for their cooking medium. Although it's cheap and efficient, the calcium in it scales the surfaces of piping and equipment. Therefore, spent sulfite liquor is normally discarded.

The new process, which is owned by Western Precipitation Corp., Los Angeles, gets around the corrosion problem by using caustic soda instead of limestone. Caustic, of course, is expensive and Western has also come up with a new, stillsecret way to recover it from the spent liquor.

Pulp made by this method has proved completely satisfactory. And the conclusions reached from the tests are that the process should prove economical in mills having a daily capacity of 150 tons or more of sulfite pulp.

News Briefs

Nylon: Commercial production of nylon staple fiber is now coming from American Enka Corp.'s new plant at Enka, N. C. Other facilities currently under construction will be producing nylon tire yarn and textile filaments by the end of this year.

Penicillin: A new \$8 million penicillin plant, the largest in South America, was recently dedicated in Sao Paulo, Brazil. It is owned and operated by Wyeth International, Philadelphia, Pa., a subsidiary of American Home Products Corp., New York.

Cellulose: Australian Paper Manufacturers, Ltd., of Melbourne, Australia, is now operating a pilot plant capable of making 500 long tons per year of dissolving pulp for chemical cellulose. Low density native eucalypt wood is converted by a prehydrolysis-kraft process. Provisions are being made to recover both tannin and furfural from the prehydrolysis stage.

WILFLEY PUMPS

A Vital Factor in **Production Continuity**

Typical Wilfley installations are shown

below. Rubber lining and stainless steel

WILFLEY'S remarkable success-record in solving a great variety of pumping problems is well known to operators of mills and chemical plants all over the world. It is a record born of engineering "know-how" plus many years of experience in keeping pace with the changing requirements of modern industry.

- Individual engineering on every application
- Cost-saving efficiency
- Reduced power and maintenance costs
- Continuous operation without attention
- Minimum replacement of parts
- Designed for simple installation
- Economical pump size for every requirement

Wilfley Acid Pump Write or wire are some of the materials used in Wilfley Sand Pumps and Acid Pumps to for provide maximum pumping efficiency. complete details. Wilfley Sand Pump

The "inside" story of ElectroniK instruments

Maybe you've never seen what's inside the case of an ElectroniK instrument. And even if you have, you might not realize how each component has been painstakingly refined to contribute its share to the overall performance and dependability of the instrument. Three of these components in particular—the converter, "Continuous Balance" amplifier and the balancing motor—are key members of the ElectroniK team with which you should get acquainted.



The Converter

is what transforms tiny direct-current signals from the thermocouple or

other sensing element into an alternating voltage that the amplifier can conveniently handle. In principle, it is somewhat like the vibrator in your automobile radio. But because it deals with such small bits of electrical energy, it has been designed of carefully selected materials which prevent the introduction of misleading signals into the measuring system. It is hermetically sealed against the effects of dust, humidity and atmospheric pressure change, and is shielded against stray electrical and magnetic fields.



The "Continuous Balance Amplifier"

boosts the incoming signals by millions of times . . . makes

them strong enough to operate the balancing motor. Although it looks like part of a radio chassis, few communications circuits could equal it for quality. It uses standard, easily obtained parts, which are operated far below their normal ratings to insure exceptionally long life. The circuit has great stability against drift and pick-up, and is thoroughly temperature compensated.



The Balancing Motor

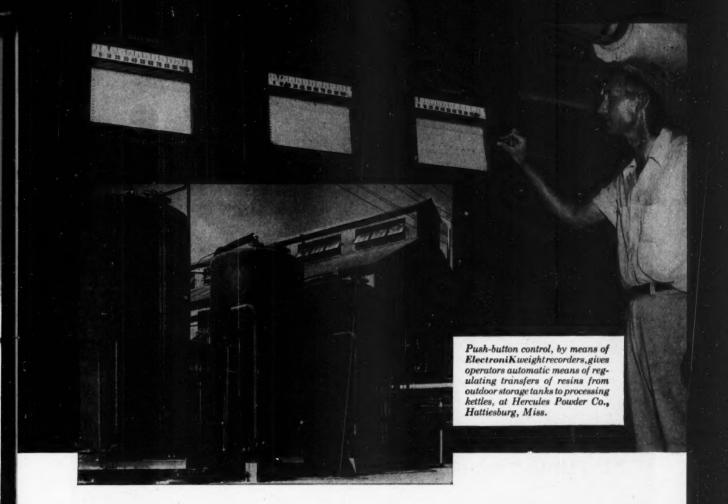
does the work of moving the pointer, recording pen and any control devices

that may be incorporated in the instrument. It packs plenty of power into a small space . . . gives ample torque to give fast, accurate positioning whenever the amplifier calls on it. Totally enclosed, the motor is impervious to dust, dirt and changes in mounting position.

Electrical weighing system measures batch



Four Baldwin-Lima-Hamilton SR-4 load cells like this one are built into the pillar mounts of the storage tanks. Connected in series to an ElectroniK recorder, they detect total weight of the tank. An adjustment in the instrument cancels out dead weight, to give direct reading of weight of tank contents.



ingredients accurately...automatically

NEED to measure transfers of materials? The automatic weighing system that Hercules Powder Co. uses for measuring resin ingredients at their Naval Stores plant may give you some new ideas.

The problem here was to transfer the required weights of various viscous liquids from outdoor storage tanks into processing kettles. The answer is electrical weighing by means of a fully automatic system that utilizes Baldwin-Lima-Hamilton SR-4® strain gage load cells and *ElectroniK* strip chart controllers. This system controls weight directly without the complications that go with conventional flow metering.

Each tank is weighed continuously by four load cells mounted under the tank-supporting beams. Output of the load cells is fed to an *ElectroniK* weight recorder. To deliver a given amount of liquid into a processing kettle, the operator sets a selector switch and moves the instrument control index downscale by

the required poundage. Pushing a button starts the cycle. Without further attention, the system pumps out the desired poundage of fluid, automatically stops the pump, records the weight delivered and steampurges connecting pipes.

Through more accurate measurement, this system helps to produce greater quality and uniformity in resin formulas. It saves time and labor, too, by giving a continuing inventory for cost-accounting purposes.

Electronic weighing systems offer endless opportunities for measuring materials in storage, or in motion. Your nearby Honeywell engineer will be glad to discuss the possibilities in your own plant's operations . . . and he's as near as your phone.

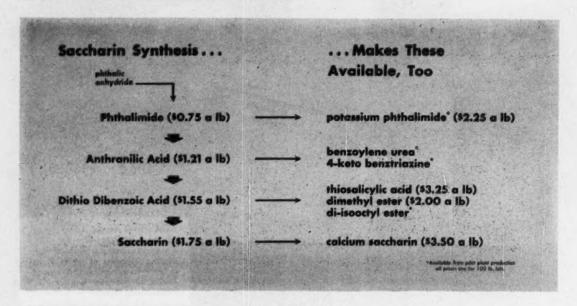
MINNEAPOLIS-HONEYWELL REGULATOR Co., Industrial Division, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● REFERENCE DATA: Write for Bata Sheet No. 10.18-la, "Unit Measuring Systems with Baldwin Electric Strain Gages," and for Catalog No. 1531, "Electronik Controllers."



Honeywell

First in Controls



Stepping-Stones to Saccharin

New commercial synthesis of old sweetener offers versatile intermediates along the way. It may pay you to give them, and saccharin, a good look.

Saccharin manufacture has a recent entry with a new angle—all set to woo not only the sweetener market but also big volume users of a number of important chemical intermediates. The entry: Maumee Chemical of Toledo, Ohio. The angle: synthesis from phthalic anhydride.

So whether you're in the saccharin business or not you'll want to know about these chemicals from the new synthesis (see page 128 for details). Any or all of them may be as useful to you as the end product, saccharin, is to the other fellow. And, incidentally, that "other fellow", the past, present and potential user of saccharin, may not fully appreciate its current position or its possibilities for the future.

That, then, is the picture at Maumee. The company is not only

cycing a good piece of the broadening sweetener market but is hopeful of cashing in on its ability to lift intermediates out of the process stream and sell them or their derivatives outright. Maumee believes it is the largest producer of all these products, saccharin excluded.

First, we'll take a rundown of the intermediate chemicals:

▶ Phthalimide—Here's an old product that has recently found a place in pharmaceutical manufacture: as a principal raw material in the synthesis of Apresolene (Ciba Pharmaceutical Products), a drug to combat circulatory disorders; and, in potassium salt form, as the springboard, via a Gabriel synthesis route, to Primaquine (Winthrop Stearns), an antimalarial.

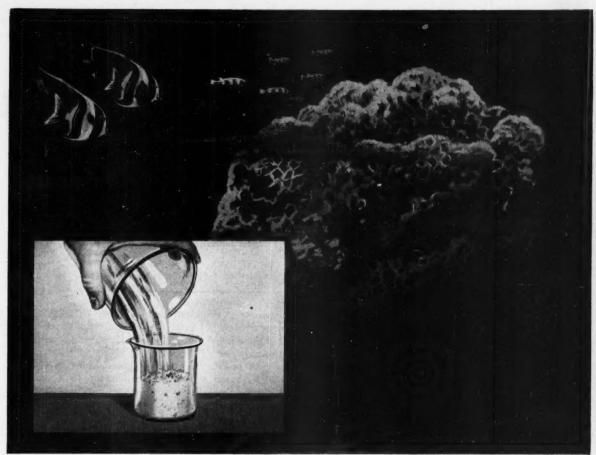
► Anthranilic Acid—Its derivatives enter such diverse fields as dyes: Violet BN, Fast Scarlet G, khaki dye for wool; pigments: Scarlet 3B used for vinyl films; flavors: synthetic grape (methyl anthranilate); perfume bases: synthetic musks from methyl anthranilate.

▶ Dithio Dibenzoic Acid—Sometimes a new process results in volume availability of a chemical formally obtainable only in limited quantity. This time it's dithio dibenzoic acid, which finds a use in making o-carboxy phenyl thioglycollic acid, an intermediate in thio-indigo manufacture.

Dithio's derivatives—such as the methyl and iso-octyl esters and thiosalicylic acid—bear the most watching, though. The new synthesis can produce these in quantity at reasonable prices; their interesting properties are expected to attract sizeable commercial use. Right now di-isooctyl dithio dibenzoate is being examined as an oil additive for high pressure work.

▶ Thiosalicylic Acid—This versatile derivative of dithio dibenzoic acid deserves separate discussion. Some of its applications:

 Pharmaceuticals — Mercury, antimony, arsenic, silver and gold compounds of thiosalicylic acid have germicidal and/or therapeutic value. Thiosalicylate ion inactivates the hormone, insulin.



Like nature's perous sponge, Celite has extremely high absorptive capacity. It absorbs 220% of its own weight of water (Gardner-Coleman method)

High absorption

Celite diatomite powders absorb twice their own weight of liquid

Here is a material in powder form, so porous that 93% of its volume consists of tiny interconnected pores. This unique structure gives Celite* an exceptionally high absorptive capacity which is now being put to profitable use in a wide variety of industries. For example, Celite serves as a dry carrier for insecticide poisons . . . helps control viscosity in adhesives . . . and makes a highly effective anti-caking agent in fertilizers.

The unique structure of the microscopic Celite particles offers many other advantages. These particles are spiny and irregularly shaped, strong and rigid ... as a result they do not pack together.

Thus Celite powders have great bulk per unit weight . . . making them valuable for fluffing up dry powders such as household cleansers . . . and extending pigments in paint and paper.

Celite's physical structure itself is also utilized in many different ways . . . as the outstanding flatting agent for paints ... as a mild non-scratching abrasive for fine polishes . . . and to improve surface appearance in plastics. And it is also the reason why Celite can add strength, toughness, stiffness, durability and many other desirable characteristics to

If you want improved product per-

formance or lower production costs, investigate industry's most versatile mineral filler. One of the J-M Celite Engineers will gladly discuss your problem. These men are backed by complete technical services and the Johns-Manville Research Center, largest laboratory of its

kind in the world. For further information write Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay St., Toronto 1, Ont.



*Celite is Johns-Manville's registered Trade Mark for its diatomaceous silica products.



Johns-Manville CELITE INDUSTRY'S MOST VERSATILE MINERAL FILLER

Products on these pages this month made news . . .

	age Number is also Reader Service code number
*	*
Chemicals from new saccharin synthesis150A	Synthetic gel
Jelly paints154A	Blood pressure depressant
Palm oil substitute	Colloidal boiler cleaners
Metal repair compound	Textile whiteners
Ultraviolet absorbers154D	Skid-resistant ink158E
Barrier cream	Low cost textile detergent
Silicones make water repellent cream 156A	Acetoacet-m-xylidide
Waste CaCO _a can be profitable156B	Butyl titanate polymer paints158H
Water proof magnesia156C	Delayed action rubber accelerator158I

. . For more about any item, use Reader Service postcard (p. 435)

 Rubber-Phenyl thiosalicylate is said to be an efficient plasticizer for both natural and synthetic rubber.

 Dyestuffs — Reaction with chloroacetic acid is the established route to thio-indigo. Reaction with 1-chloro anthraquinone leads to thioxanthone dyes.

 Miscellaneous — Reaction product with chloral is an effective high pressure additive for petroleum products.

► Saccharin—So much for the intermediates. Let's talk now about saccharin, Maumee's basic chemical.

Three problems face the company in the sweetener field: national and state regulations restricting saccharin usage in foods; competition from other saccharin producers; and the new synthetic sweetener, Abbott's Sucaryl.

As recently as a few years ago 27 states did not permit the use of saccharin in foods, largely because of ancient price wars. (The picture is a good deal brighter now, though: only 15 states ban its use in beverages; 10, in other foods.) When saccharin was first offered commercially more than fifty years ago some sugar producers, entrunced by saccharin's high-powered sweetening potency (400 times sucrose), used the synthetic as a partial substitute for natural sugar. Three rapid fire results: lower priced "sugar," turmoil in the ranks of the non-price cutters and, finally, legislation in many states-instigated by stable price interests-prohibiting saccharin in any food.

Sweet Tooth-Most of these laws have hamstrung nation-wide saccharin usage, especially in beverages, all these years although the synthetic has found other, non-food, applications; these range from tobacco to pH indicators to electroplating (Udylite Corp.'s patented process for obtaining a bright, smooth nickel surface in the plating bath uses saccharin).

Recent developments, however, have given saccharin's adherents a shot in the arm. Urged by strong pressure from a public with an exceedingly sweet tooth but with an increasingly attentive eye on its avoirdupois, the market for non-caloric sweeteners has been expanding mightily. The Food and Drug Administration has been prompted by all this to review the situation and recommend new policy and legislation for the use of synthetic sweeteners and the manufacture and sale of special dietary products.

Regulations in newly-opened states will, however, be consistent with general legislation in that no sugar adulteration with synthetics is permissible. All foods will contain either no artificial sweetener or all artificial sweetener and, in the latter case, must be so labeled.

But Maumee is not pinning all its hopes on virgin markets; the company is finding present saccharin users who welcome a second source of supply by giving part of their orders to Maumee. As an added inducement to buyers, Maumee claims its product, derived as it is from phthalic anhydride rather than toluene, is free of the trace impurity – o-toluene sulfonamide – held responsible for the bitterafter-taste often associated with saccharin.

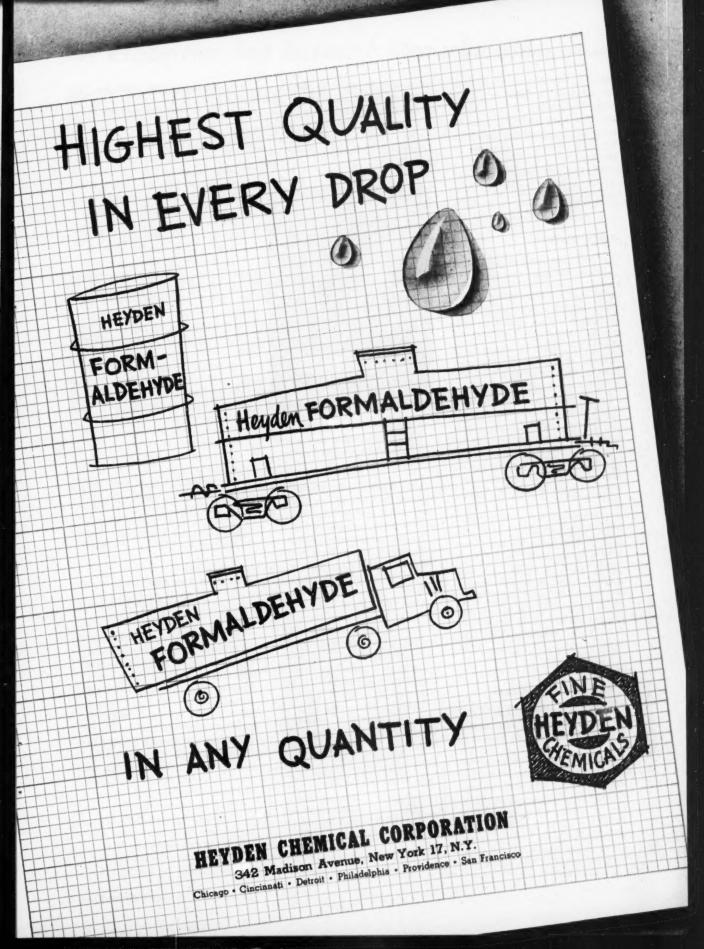
► Sucaryl vs. Saccharin—Sucaryl, the newcomer-it's only four years oldhas exploded from nowhere to grab up most of the latest dietary market, non-caloric beverages. Saccharin, holding two aces but slowed down by red tape-true it's shed a lot of legislation recently but it was pretty snarled up when Sucaryl, less encumbered, made its move a couple of years ago-is hoping to increase its share of beverage usage. The red tape we've mentioned. The top cards-saccharin is more economical and sweeter than Sucarvl.

• It costs less—Saccharin is priced at \$1.75 a lb.; Sucaryl at \$3.50-\$3.85 a lb. Calcium saccharin, first introduced in Maumee, costs \$3.50 a lb.

• It's sweeter—300-400 times sweeter than sugar, depending on concentrations involved; Sucaryl is only 30 times as sweet as sugar—a clear-cut 10 to 1 advantage to saccharin over Sucaryl.

Put another way, this means that whereas Sucaryl costs slightly more than natural sugar to get the same sweetening effect, saccharin can cost as little as 1/20 as much to do the same job.

But Sucaryl claims some big ad-



vantages, too: it's lack of unpleasant aftertaste (a factor in its soft drink acceptance) in normal use and even after heating to cooking temperatures. Saccharin's sidetaste has been reported accentuated by cooking.

Maumee's "tastier" saccharin may do very well for itself on both these counts. 150A

Jelly Paints

New paint vehicles give gelled consistency, prevent settling.

Oil base paints are being offered which possess unique storage and application virtues. Based on new vehicles and older thixo-tropic alkyds, the paints in their natural state are thick, jelly-like and nonflowing, need never be stirred, are ready for use at any time.

• Storage—Paints stored more than two years showed no settling, had their original consistency, were ready to use without stirring or thinning. Color uniformity was unimpaired—no tint color floating on the surface and no pigments congealing on the bottom of contain-

Application — Thixotropic paint dipped out of the can in jelly form neither drips nor runs. Friction of brush contact with surface causes paint to thin and flow smoothly while applying. As brushing ceases the paint quickly firms again, preventing sagging, curtaining and beading on the painted surface.—T. F. Washburn Co., Chicago, Ill.

Palm Oil Substitute

Processed beef tallow makes our steel industry independent of African palm oil imports.

Specially prepared beef tallow can be substituted for palm oil used in steel processing. The steel industry, largest U.S. consumer, used 17,000 tons of Belgian Congo palm oil in 1953 as a lubricant in cold-rolling sheet and strip steel and as an aid in hot dipped tinning of such steel.

Development of beef tallow as a

satisfactory alternate in these applications is insurance against possible dislocation of palm oil imports and flow of tin plate to can manufactures and canners.—American Iron and Steel Institute, New York 1, N. Y. 154B



Metal Repair Compound

Al-epoxy resin compound is hard machinable and chemically stable, repairs castings, molds and dies.

Metalset A-101 can be used for repairing castings, filling joints in sheet metal and building up surfaces of patterns, molds and dies.

An aluminum-containing epoxy resin, the product hardens by polymerization (a curing agent is required) with negligible shrinkage, will not crack. It can be cast or applied with a putty knife, adheres strongly to metal, particularly aluminum, is machinable to a feather edge and has excellent chemical stability.

Photograph (above) shows wedge shaped section in metal disc being filled with Metalset.

Metalset A101 costs \$1.00 for 6 oz., \$5.00 for 3 lb.—Smooth-On Manufacturing Co., Jersey City, N. J.

For More Information . . .



about any item in this department, circle its code number on the Reader Service

Postcard inside the back cover.

Ultraviolet Absorbers

Act as protective coatings and stabilizers.

New chemicals are available to protect materials from the deterioration caused by ultraviolet radiation. Uvinul 400 and Uvinul 490 not only work in transparent films to shield surfaces but act as stabilizers for materials subject to degradiation by ultraviolet light.

Uses as protective agents are:
 In lacquers—to retard the darkening of bleached furniture woods.

In plasticized cellulose acetate for transparent sheets used as screens for U. V. Sensitive materials—photos, foods, chemicals.

In coatings and finishes—for textiles, leather, paper.

In waxes, polishes, oils, creams for surfaces to which these products are applied.

• Uses as stabilizers are:

In translucent, opaque, or clear plastic sheets—to stabilize selected colors against U. V. fading.

In polymethylmethacrylate – to serve not only as U.V. filters but also minimize crazing of the sheet caused by decomposition products.

In polyester resins—to prevent discoloration and deterioration in sunlight.—Antara Chemicals, New York 14, N. Y. 154D

Barrier Cream

Protects against dermititis, one of industry's major headaches.

Kerodex, a cream designed to act as a barrier between the skin and agents which irritate and damage the skin, is available for the first time to American industry. Used successfully in Canada and Europe for more than ten years, the cream is offered as a partial answer to the problem of absenteeism due to acquired skin disorders, a problem with an overall cost, according to the U.S. Public Health Service, of one hundred million dollars a year.

Prime function of a barrier cream is to preserve the normal condition of the skin by keeping pores and follicles free from foreign matter. This and other closely related qualities are claimed for Kerodex: it is

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To Help You make preliminary evaluation of these important new process chemicals, General Chemical has prepared a special data sheet for each. These sheets cover pertinent physical and chemical properties, suggested uses, containers, etc. Since

many of these fine chemicals are relatively new to the industrial scene, data on them are frequently not available in standard references, thus you will find these particular B&A data sheets of more than ordinary value.

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The following fine chemicals represent a small cross section of the many high purity chemicals bearing the "B&A" shield of quality. Please put check in box before name of each product on which you want further information.

Product	Data Sheet No.
Acetyl Chloride, Technical	DA-30151
Acid Hydrofluoric, 48% (C.P.) A.C.S.	DA-49791
Acid Oxalic, Anhydrous, Technical	DA-31341
Aluminum Chloride, 32° Bauma Solution	DA-83851
Aluminum Fluoride, Powder, Technical	DA-32521
Aluminum Nitrate, Crystal, Technical	DA-32341
Aluminum Sulfate, Hexahydrate, Technical	DA-48871
Ammonium Acetate, Crystal, Purified	DA-32711
Ammonium Flueborate, Crystal, Technical	DA-32731
Ammonium Fluoride, Crystal, Technical	DA-32671
Ammenium Oxalate	DA-33251
Ammonium Sulfate, Purified	DA-33151
Ammonium Thiosulfate, Solution, Technical	DA-85271
Barium Fluoride, Technical	DA-34181
Calcium Acetate, Powder, Purified	DA-34991
Calcium Chloride, Anhydrous, Purified	DA-49211
Calcium Chloride, USP	DA-35011
Calcium Fluoride, Powder, Reagent	DA-35201
Calcium Phosphide, Technical	DA-35341
Chromium Fluoride, Technical	DA-35771
Chromium Potassium Fluoride, Purified	DA-35791
Chromium Potassium Sulfate, Granular, Phot	DA-35841
Cupric Fluoride, Technical	DA-36481
Cuprous Chloride, Technical	DA-36571
Ferric Nitrate, Crystal, Technical	DA-37441
Ferrous Ammonium Sulfate, Crystal, Technica	of DA-37571
Load Nitrato, Crystal, Technical	DA-38371
Magnesium Fluoride, Purified	DA-39121
Oxomide, Purified	DA-48651
Potassium Acetate, N. F., & Crystal, Technical	DA-40821
Potassium Biffuorido, Technical	DA-41461
Potassium Borate, Totra, Purified	DA-40771
Potassium Cyanato, Powder, Purified	DA-41591
Potassium Cyanate, Powder, Technical	DA-48821
Potassium Flueborate, Crystal, Technical	DA-41361
Potessium Fluoride, Anhydrous, Purified	DA-40911
Potassium Fluoride, Crystal, Purifie.	DA-41041
Patassium Nitrite, Fused, Lump	DA-85521
Potassium Titanium Fluoride	QA-40721
Sodium Flueborate, Crystal, Technical	DA-42401
Stannous Chloride, Crystal, Technical	DA-43421
Zinc Fermate, Crystal, Purified	DA-44441

BAKER & ADAMSON FINE CHEMICALS GENERAL CHEMICAL DIVISION Allied Chemical & Dye Corporation 40 Rector Street, New York 6, N. Y.



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nonsensitizing and nonirritating; may be applied safely and effectively to the face as well as the hands; does not affect materials handled and is unaffected by them; is economical and easily applied; protects for three or four hours.

Considerable improvement in workers' health and productivity is reported by industries using Kerodex: transportation, chemical, rubber, paints, construction, foods, plastics and printing. In these jobs the cream has protected against contact dermititis caused by primary irritants-acids, alkalis, solvents, oil, tar and pitch-as well as sensitizers -nickel, rubber, chromates and even poison ivy. One grade of Kerodex is designed specifically to deflect irritating light rays, including ultraviolet and infra-red.-Ayerst Laboratories, New York 16, N. Y.

Put Waste CaCO₃ to Work

By applying a few simple processing techniques mostly drying—you can turn now-wasted calcium carbonate into products selling for as much as \$55 per ton.

Industrial processors with mountains of calcium carbonate waste deposits in their back yards—and there are a lot of them—can profitably dispose of the stuff, according to Robert Noor, consulting engineer.

Users of dolomite—calcium magnesium carbonate—in the production of asbestos, 85 percent magnesia, insulation and chemical and pharmaceutical magnesium oxide have each accumulated "waste" CaCO_a in excess of several million

pounds. Much of the material now in stockpiles is approximately 65 percent wet and as such is worthless. But, for freshly produced or protected deposits, substantially pure except for dirt, profitable utilization is possible as follows:

• Drying—A simple operation will produce a saleable calcium carbonate competing with commercial whiting selling from \$6 to \$40 a ton, depending on refinement, mesh size and apparent specific gravity.

Another drying operation at 500 deg. F. will yield a product equivalent to commercial precipitated chalk used for fillers in rubber and paint and as agricultural lime. Total operating expense: about \$1.50 a ton. The lime grade will bring \$9 a ton but the purer material, if ground to desirable mesh sizes, can sell for \$13 per ton (putty), \$30 per ton (rubber) and \$40 per ton (paint filler).

• Calcination — Burning temperatures of 1,500 deg. F. would give a calcium oxide competitive with material selling at \$9 per ton. No size reduction is required.

 Hydration of CaO-Resultant hydrated lime could sell as a building material at \$10 per ton.

The small but high price pharmaceutical and drug markets pay \$55 per ton for very pure grades of all these possible products and should be investigated.—General Industries, Inc., Philadelphia, Pa. 156B



Silicones make skin cream water repellent

The hand pictured at the left has just been dipped in ink. The still-white areas had been previously covered with a skin cream based on Dow Corning 555 silicone fluid. These treated portions rinse clean easily (right) but soap scrubbing will be necessary to remove the rest of

the stain. DC 555 is water-white, odorless and readily diluted with such materials as lanolin, beeswax, mineral oil and 95 percent ethanol, is designed as an easily blended, non-separating ingredient for cosmetics and ointments. — Dow Corning Corp., Midland, Mich.

Water Proof Magnesia

Piping insulation survives brutal tests: steam inside pipe, boiling water outside.

A new form of 85 percent magnesia insulation is highly resistant to severe moisture conditions; it's tailored for underground pipe lines

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subjected to flooding, process equipment and piping requiring hosing.

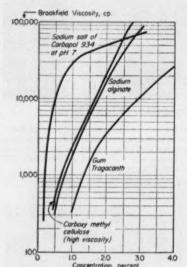
Pittsburgh Testing Laboratory subjected hot steam piping covered with the insulation to 378 hours of immersion in boiling water with intermittent drying out (510 hours)-30 cycles in all. The 85 percent magnesia suffered no loss of insulating values, only a slight roughening of its surface.-Magnesia Insulation Manufacturers Association, Washington 4, D. C.

High viscosity gels are attainable with lower concentrations of Carbopol than with many other commercial thickening agents (see cut): solutions of one-half, one and three percent reach maximum viscosities of 10,000, 30,000 and 70,000 centipoises, respectively. And once attained, these viscosities are only slightly affected by temperature variations or 24 hr. ball milling.

Carbopol and its salts are not

subject to hydrolysis or polymeric degradation caused by bacterial or fungal attack. They are good suspending agents for solids dispersed in aqueous systems; as little as 0.05 percent added to dispersions of antimony oxide, titanium dioxide. whiting or iron oxide pigments prevents formation of hard-to-redisburse cakes.-B. F. Goodrich Chemical Co., Cleveland 15, Ohio.

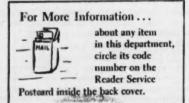
158A



Synthetic Gel

Its aqueous solutions congeal when treated with alkali.

A unique gel-forming gum has been introduced that should interest the cosmetic, pharmaceutical, paint, textile and related industries. Carbopol 934, a hydrophilic polymer, dissolves in water to form low viscosity, low pH solutions which, when neutralized, congeal to high viscosity gels. Degree of viscosity depends on the acid polymer concentration and extent and type of neutralization employed.



Product Briefs

A new blood pressure depressant, arfonad, permits surgeons to almost completely control bleeding in difficult operations on the head, neck and chest. Dangerous blood transfusions and post operative shock are avoided. Arfonad acts quickly and its effects subside rapidly after the operation.-Hoffmann-La Roche, Inc., Nutley, N. J.

Non-chemical, colloidal formulas for boiler cleaning, Series 31-H Formulas, hold scale, oil and grease in suspension, keep operation-interrupting deposits from forming. Tests with more than 1200 boilers show complete cleaning in 30-40 days without shutdown or failure.-Water Treatment Co. of America, Pittsburgh 12, Pa. 158C

New optical textile whiteners are Safaritone White WNOA and Safaritone White C. WNOA possesses level dyeing characteristics on wool, nylon, Orlon and acetate. Warm-water-soluble, it requires no separate dyebaths and neutralizing. White C is designed for all temperature whitening of cotton bleached or viscose rayon goods. - Hilton-Davis Chemical Co., Cincinnati, Ohio.

Skid-resistant printing ink can solve many shipping problems of manufacturers and users of industrial packages. Hydry Non-Skid Ink minimizes sliding, shifting and extra handling of bags, cartons, etc.-Sun Chemical Corp., Long Island City, N. Y.

Nopco 1479A is claimed to be the lowest cost synthetic detergent on the market for the textile industry. A liquid fatty alkylolamide, it has high foaming action, excellent scouring properties .-Nopco Chemical Co., Harrison. N. J.

Acetoacet-m-xylidide-usually imported-is more available now from domestic producton. Yellow benzidine pigments pre-pared from this product have remarkable light fastness, are used in printing inks, textiles. Price: \$3-3.25 a lb.-Carbide and Carbon Chemicals Co., New York 17, N. Y. 158G

Polymerization gives butyl titanatebased paints qualities other than heat resistance. Pigmentation with zinc dust gives butyl titanate polymer outstanding anticorrosion properties-especially in marine uses. They dry satisfactorily at ordinary temperatures .-Australian Defense Standards Labs, Melbourne, Australia, 158H

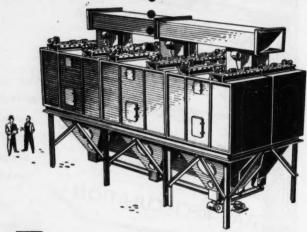
A new "delayed action" accelerator, Nobs Special, protects rubber compounds against processing scorch by not catalyzing vulcanization until the rubber in the mold is heated to the proper temperature. The delay-up to 10 minutes-allows longer rubber flow in the mold, reduces surface defects and flow cracks. Best use is with high pH furnace blacks .-American Cyanamid Co., Bound Breek, N. J.



DUST RECOVERY

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GIANTS!



t the Climax Molybdenum Co., Langeloth (Pa.), the complete recovery of product fines presented no ordinary dust problem. Filters which would be veritable giants were needed to control ferromolybdenum fumes—tough to handle because of their light weight and voluminous characteristics.

To solve Climax's problem, Dracco custom-engineered an entirely new Dracco Dust Control System—the extremely rugged "DH" Filter. Designed for continuous, automatic service, these Dracco giants operate under heavy-duty conditions.

At Climax, twelve Dracco "DH" Filters with a capacity of 60,000 CFM are integrated with process equipment used in the manufacture of metallurgical compounds. While operating only intermittently, they capture some one-and-a-half tons per day of valuable ferromolybdenum fumes. All reclaimed materials are returned directly to process for re-use.

Whether your dust control or recovery problem is complex or simple, rely on Dracco for the profitable, engineered-for-efficiency solution. Call in a Dracco engineer today!

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Intake manifold to 60,000 CFM

Dracco "DH" Filter System handles heavy dust load from pot furnaces.

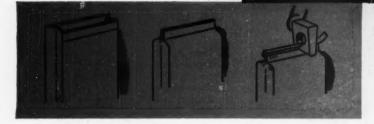
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It's the Crease that does it!

- Makes bagtop forming easier
- Speeds Bag closing
- Insures better filling
- Produces a better-looking package

Bagpak, the first to introduce multiwall bags to many industries, then improved them with the PREFORM top for easier, time-saving uniform closing. Now the PREFORM feature at the bottom means easier opening for faster, more complete filling.

You profit because your bags are filled, formed and closed in record time. You package bigger tonnage daily—and there's no waste.

Asking for complete information and prices places you under no obligation. Just write today to Dept. E-19

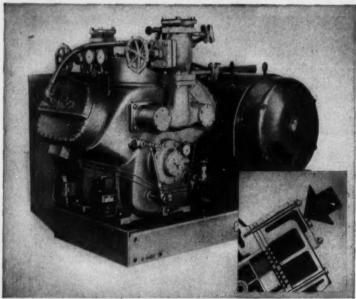


International Paper Company, Bagpak Division 220 E. 42 Street, New York 17

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BRANCH OFFICES: Atlanta - Baltimore - Baxter Springs, Kansas - Boston - Chicago - Cleveland - Dalias - Denver - Detroit - Kansas - City, Kansas - Los An Minneapolis - New Orleans - Philadelphia - Pittsburgh - St. Louis - San Francisco - IN CANADA: The Continental Paper Products, Ltd., Montreal,

Look at all the features of Worthington's new high-speed ammonia compressor



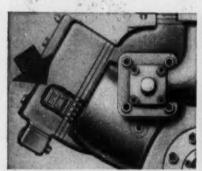
IMPROVED INTERNAL MANHOLDING—cool suction gas completely surrounds the cylinder walls, providing longer valve life and increased overall efficiency. All passageways between suction discharge and shutoff valves are cast integrally within the crankcase, eliminating outboard fittings. Cross section shows water jacketing on one of the cylinders.

High operating efficiency and lighter weight make this modern unit the talk of the industry

These lightweight, compact Worthington ammonia compressors have the same high operating efficiency and versatility as their lower speed counterparts.

Ranging in capacities from 18 to 150 tons, the new units can be used as high-stage or booster machines.

Get in touch with your nearest Worthington district office for more facts about these rugged compressors. Or write to Worthington Corporation, Air Conditioning and Refrigeration Division, Section A.3.56, Holyoke, Mass.



ELECTRIC UNLOADING—a new achievement in variable capacity control. You can start compressor with a normal torque motor; power consumption is automatically balanced against load. Separate unloader units allow easy maintenance... no oil or gas pressure lines to worry about.



MEW SUCTION MANIFOLD, with cover plate over suction strainer inlet, allows easy removal of the suction gas strainer for cleaning, without disturbing any of the pipes, valves or other parts. The strainer is unique in that it fits entirely within the crankcase manifold, requiring no additional space.



NEW FORCE-FEED LUBRICATION SYSTEM — full pressure, positive lubrication, regardless of rotation. A new rotary oil pump, driven directly by the crankshaft, eliminates complicated and noisy gear trains. Oil is filtered through a strainer in the crankcase for protection of pump and other moving parts.

A.3.56

WORTHINGTON



CLIMATE ENGINEERS TO INDUSTRY, BUSINESS AND THE HOME

YOU CAN Specify MINIMUM MAINTENANCE COSTS WITH Americal Protective Coatings

ONLY AMERCOAT PROVIDES YOU WITH

The most complete line of corrosion resistant coatings available anywhere

Field service backed by an organization SPECIALIZING in corresion control

The service life of your equipment—the efficiency of your production schedules — the ultimate value of your investment and maintenance dollars — all are vitally dependent on the continuing performance of the protective coatings specified in your plant. Thus, success or failure of your coatings can mean the difference between tremendous losses or substantial savings.

To assure coating performance that provides long-lasting, low-cost protection, two steps are absolute essentials, right from the start. You need the right coating for each specific exposure, and it must be applied properly if it is to yield maximum benefit.

AMERCOAT ELIMINATES THE GUESSWORK-MINIMIZES MAINTENANCE COSTS

First of all, AMERCOAT provides the right coating for the particular problem. From the complete AMERCOAT line, it is possible to provide specific coatings for specific exposures to achieve specified protective performance.

In addition, you receive the added value of AMERCOAT's conscientious service follow-through backed by an organization SPECIALIZING in industrial corrosion control. With the assistance and on-the-spot advice of a trained representative, you get the best possible application through proper attention to surface preparation and correct coating techniques.

Investigate AMERCOAT now. It's your surest way to effective, longterm corrosion control. An experienced representative is near you to serve you. For complete details write today.

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Solution to a Hot Solution Problem

Carpenter Stainless No. 20 Handles H₂SO₄ —Solves Corrosion Problem In this spray booth metal parts are cleaned by a solution of hot sulphuric acid. Booth is fabricated from Carpenter Stainless No. 20 Cb pipe, tubing, sheet and plate.

When you have sulphuric acid or other strong corrosives to handle—or are fabricating equipment to do the job—remember Carpenter Stainless No. 20—also available in bar, wire and strip.

Highly resistant to concentrations or solutions of H₂SO₄, and unaffected by a long list of other highly corrosive acids, liquids, gases, Carpenter Stainless No. 20 cuts the cost of corrosion control. What's more, it has the ductility and general workability for trouble-free bending, machining, threading, welding and brazing.

Now is the time to get complete information on



Carpenter Stainless No. 20 Cb in its many forms—see what it has to offer you. Write today for your copy of the Carpenter Stainless No. 20 handbook. It contains data on physicals, corrosion resistance, fabrication.

The Curpenter Steel Company, Alloy Tube Division, Union, N.J.

Export Dept.: The Carpenter Steel Co., Port Washington, N. Y.—"CARSTEELCO"



By all indications YOUR BEST BUY

CLIMATE-PROOF CASE. Rain tight . . . snow tight . . . dust tight . . . sand tight . . . frost tight. The American Bi-Metal Thermometer can withstand submersion, hot blasts, dust, hot gases, extreme temperature changes and long exposure to the elements.

MAXIMUM RESPONSE — MINIMUM FLUTTER. Highly sensitive dampening fluid on bi-metal coil assures fastest response to temperature changes and greatest resistance to pointer flutter and destructive vibration.

ALL WELDED STEM CONSTRUCTION. Processing media cannot seep into case. Stem is stainless steel—corrosion-resistant—contributes to longer thermometer life.

Refineries, chemical and other processing plants find the American Bi-Metal Dial Thermometer "tops" for on-the-spot temperature readings.

Accuracy is guaranteed within 1% of the scale range. Application is simple and fast. Adequate clearance at back of case permits easy use of wrench during installation. Get complete information about these precision-built, long-life thermometers. Write for Bulletin 144.

YOUR INDUSTRIAL SUPPLY DISTRIBUTOR is as close as your telephone. Take advantage of the broad experience of his organization and his ability to meet your most exacting requirements quickly from local stocks.



Accurate

AMERICAN BI-METAL DIAL THERMOMETERS

SPECIFICATIONS

Temperature Ranges: From minus 60° to 1000° F.

Dial Sizes: $3\frac{1}{2}$ " and 5". Graduations over full 270° arc.

Case: Aluminum alloy with smooth, black enamel instrument finish.

Bezel: Screwed to case.

Front: Heavy plate glass set in channeled gasket seals the case.

Pointers: Adjustable type attached with set screw; easy to get at for setting.

Connection: Fixed, 1/2" N.P.T.

Separable Sockets: Available for use in closed systems or where the measured medium is corrosive to the stainless steel stem. Fit over all standard stem lengths except 2½".





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A product of MANNING, MAXWELL & MOORE, INC. STRATFORD, CONNECTICUT
MAKERS OF 'AMERICAN' AND 'AMERICAN-MICROSEN' INDUSTRIAL INSTRUMENTS, 'HANCOCK' VALVES, 'ASHCROFT'
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STAINLESS

STEEL

TANKS

used for petrochemical storage at Pampa

Beneath the black protective coatings in the view above are three of six 200,000-gal. solid stainless steel Horton® tanks erected for Celanese Corporation of America's petrochemical plant at Pampa, Texas. At this plant petroleum byproducts, useless less than thirty years ago, serve as raw material that is processed to provide us with a multitude of articles we use and wear daily.

The Horton tanks shown are 33\frac{1}{2}-ft. in diam, by 30\frac{1}{2}-ft. high. The roofs are supported by 5-in. carbon steel rafters on top of the roof plates. The tanks are used for the storage of finished chemicals that are produced at Pampa.

Write our nearest office for information, estimates or quotations on Horton stainless steel tanks or any other Horton welded steel plate structures. There is no obligation on your part.

CHICAGO BRIDGE & IRON COMPANY

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Handclasp of a friend-in-need

There's confidence in the very "feel" of the world famous C-O-TWO Squeez-Grip Carbon Dioxide Type Fire Extinguishers. The quick-acting "Squeez-Grip" fits your hand naturally like a handclasp...hangs right...carries right... works right. You're in complete command of the situation instantly...no fumbling...no fatigue.

From the non-conducting, shatterproof discharge horn to the high strength, durably finished cylinder, you get top quality construction that results in a lifetime of satisfactory service. Because of the very few working parts and corrosion resistant materials throughout, the total cost to you over the years is less than other initially lower priced makes... fire after fire, recharge after recharge, without trouble.

It's not hard to see, when you fully compare and try, why C-O-TWO Squeez-Grip Carbon Dioxide Type Fire Extinguishers are your test buy for killing flammable liquid and electrical fires, as well as some surface fires involving ordinary combustible materials. Sizes range all the way from $2\frac{1}{2}$ to 100 pounds capacity...all fully approved by the Underwriters' Laboratories, Inc., Factory Mutual Laboratories, Armed Forces and Government Bureaus.

With C-O-TWO Squeez-Grip Carbon Dioxide Type Fire Extinguishers the penetrating carbon dioxide is a clean, dry, non-damaging, non-conducting, inert gas...smothers fire instantly, leaves no after fire mess...harmless to equipment, materials and finishes...even food is still perfectly edible.

Act now for complete free information on these first-rate, sure-acting fire extinguishers. Remember fire doesn't wait ... get the facts today!



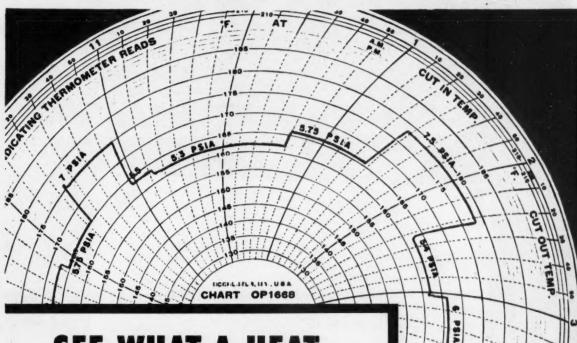
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SEE WHAT A HEAT EXCHANGER <u>CAN</u> DO... WHEN IT'S A <u>DE LAVAL!</u>

This chart, made under normal operating conditions, shows the temperature of the heated product of a De Laval Plate Heat Exchanger, using the De Laval Vacuum-Steam Heating System, in which temperature is controlled by the amount of vacuum (shown on the chart in psia) applied to the steam in the heating section.

Note these two outstanding features:

(1) The straightness of the lines at the various temperatures—lines which, while straight, have "life" in them, indicating the sensitivity of the instruments...(2) The immediate and sharp response to each demand for a temperature change. Quite obviously there is no "seeking" for the correct temperature.

Here is proof that the De Laval Plate Heat Exchanger and the De Laval Vacuum-Steam Heating System, together, provide a simple method for accurate control of product temperature with instant response to any change in operating requirements.

For complete technical information regarding De Laval Plate Heat Exchangers for heating, cooling or regeneration...

Write for De Laval's Bulletin PHX.

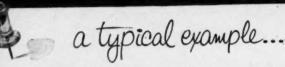
THE DE LAVAL SEPARATOR COMPANY
Poughkeepsie, New York ● 427 Randolph St., Chicago 6
DELAVAL PACIFIC CO., 61 Beale St., San Francisco 5



For production on an even level

Uniform production depends largely upon uniform ingredients. The uniformity

of Nialk chemicals is recognized throughout the chemical-using industries.



NIALK CARBONATE OF POTASH: Good production schedules are maintained in the pharmaceutical and vitamin fields only when the uniform purity of vital ingredients is assured. Many leading drug houses specify NIALK Carbonate of Potash, knowing that its uniform high quality contributes to smooth production.

This uniformity in all NIALK chemicals is an important factor in keeping production on an even level in many fields.

NIAGARA ALKALI COMPANY

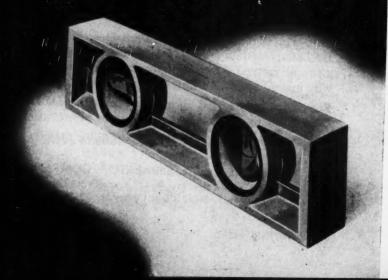
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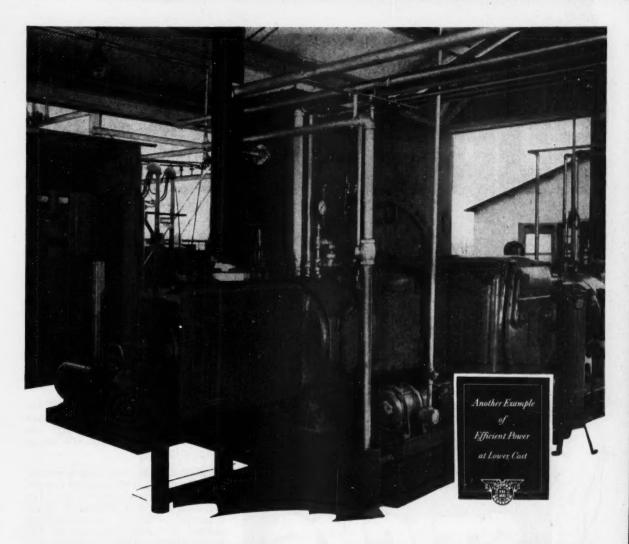


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Cooper-Bessemer Compressors operate "on their own"

ACTUALLY, the statement that Cooper-Bessemers are "on their own" is far from an exaggeration. For example, this single stage Cooper-Bessemer FM-2 compressor, installed in a Michigan refinery, runs 24 hours a day without operating personnel.

This money-saving advantage is made possible by highly efficient Cooper-Bessemer controls which automatically handle all phases of the compressing operation.

Moreover, in this plant's processing, contamination by oil is completely avoided. Therefore, the FM unit is equipped with Cooper-Bessemer carbon pistons, operating against micro-honed mirror finish liners, requiring no lubricating oil whatever! — a highly important factor in various processes involving compressed air and other gases.

Whatever your compressor requirements may be, from 100 to 5000 hp, Cooper-Bessemer offers you unique advances assuring the highest efficiencies combined with lowest cost operation. Your nearest Cooper-Bessemer office will gladly give you the specific information you may require.

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New York City * Seattle, Wash. * Bradford, Pa. * Chicago, Ill. Houston, Dallas, Greggton, Pampa and Odessa, Texas Washington, D. C. * Shreveport, La. * San Francisco, Los Angeles, Calif. * St. Louis, Mo. * Gloucester, Mass. * New Orleans, La. * Tulsa, Okla. * Cooper-Bessemer of Canada Ltd., Edmonton, Alberta—Halifax, Nova Scotia.

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Super 65



Conforms to Commercial Standard CS-117

Insulating Cement



Because Eagle-Picher Super "66" Insulating Cement *really sticks*, it has money-saving advantages that are apparent the minute your crew begins to apply it.

Because it sticks—less time is wasted in application—it stays where you put it whether the equipment is heated or temporarily out of service. It "holds together" — usually no reinforcing needed on applications up to 1½ inches thick.

Because it sticks—Super "66" can be used effectively, economically on all types of surfaces—flat, curved, overhead—anywhere you need insulation. It's truly an all-purpose cement.

And—Super "66" is rust-inhibitive—cannot cause corrosion—actually helps prevent corrosion of costly equipment.

If you've never tried Eagle-Picher Super "66," it will pay you to learn more about it today!

"Springy Ball" structure—the secret of the high thermal efficiency of Super "66." These small, resilient pellets of mineral wool, each one honeycombed with thousands of minute air cells, effectively resist the flow of heat even when used on equipment heated to 1800 F.

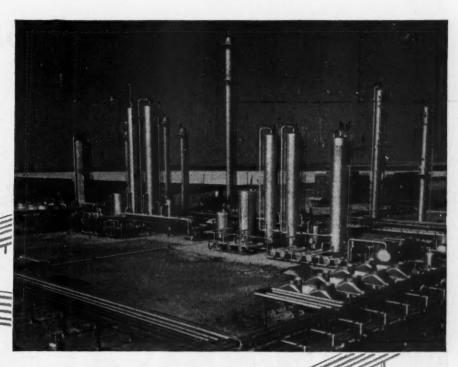
Since 1843



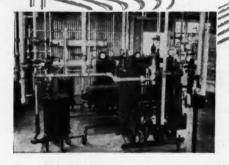
THE EAGLE-PICHER COMPANY

General Offices: Cincinnati (1), Ohio

For greater efficiency, protection and economy, you should investigate these Eagle-Picher products:
Insulating Felts • Insulating Block • Blankets • Loose Wool • Mineral Wool Pipe Covering • Stalastic
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Member of Industrial Mineral Fibre Institute



"Whenever We Install Instruments," We Prefer To Install Air Driers... regardless of outside humidity!"



This fully automatic Lectrodryer DRYs instrument air prior to its being fed to the many pneumatically operated instruments at the Stanolind Oil & Gas Company's Stano Gasoline Plant, Ulysses, Kansas, pictured above. "There's no cause to worry if you DRY instrument air. It assures trouble-free operation." These statements were made by the Stearns-Roger Company of Denver, the firm that engineered the Stanolind Oil & Gas Company plants of the type pictured.

To prevent cold weather air line freeze-up... to halt rust, scale and sludge in air lines, you must get rid of moisture. You can do this by installing a Lectrodryer*. These machines work continuously, automatically and economically, extracting vaporous moistures from instrument air...reducing the dewpoint in air lines to as low as -100° F.

Install a Lectrodryer in your instrument air lines. It's the safest and most economical way to keep harmful moisture from your instruments.

Write for Because Moisture Isn't Pink, a booklet describing what Lectrodryers are, how they work and how they are being used in industry. Pittsburgh Lectrodryer Corporation, 303 32nd Street, Pittsburgh 30, Pennsylvania.

In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI. In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

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LECTRODRYERS DRY
WITH ACTIVATED ALUMINAS

LECTRODRYER

No costly maintenance problem here



Corrugated Transite has been featured in this contemporary plant design. The shadow lines of the corrugations provides decorative interest for the large wall areas. build with Transite
Corrugated Asbestos Sheets

For maintenance-free exterior walls and roofs, plus protection from fire, rot and weather

You save money on construction and maintenance when you build with Johns-Manville Corrugated Transite. Corrugated Transite comes in large sheets that require a minimum of framing... permits fast economical construction of maintenance-free industrial, commercial, institutional and agricultural buildings.

Made of asbestos and cement, Corrugated Transite is practically indestructible. It never needs paint or special treatment to preserve it . . . it's fireproof, rotproof and weatherproof. Corrugated Transite is also used increasingly for smart interiors . . . the streamlined corrugations and attractive shadow lines that give it such unusual architectural appeal for exteriors offer unlimited interior design possibilities.

Investigate Johns-Manville Corrugated Asbestos Transite and learn how you can build quickly and easily . . . have an attractive, long-lasting, trouble-free structure regardless of size or purpose. For complete details write Johns-Manville, Box 158, Dept. CE, New York 16, New York. In Canada write 199 Bay St., Toronto, Ontario.



- Large sheets go up quickly
- Easy to fasten to steel
- Easy to nail to wood
- Easy to saw
- · Easy to drill



M Johns-Manville



This combination provides corrosion resistance well above the moderate need in many processing services with an investment well below that for allstainless steel valves.

Designed primarily for the chemical process industries, they are recommended for control of mildly corrosive liquids with minimum quantities of mineral acids, such as creosote in wood treatment, and many liquids carried in petroleum processing.

A major use is in pulp and paper processing, particularly in lines serving the digester, and in the chemical recovery cycle. Service records in lines carrying the valve-punishing "black liquor" give Jenkins Nickel Iron Valves top performance rating.

Jenkins extra value construction throughout. Get details - compare. See why they stretch your valve investment dollar - with longer service life, lower maintenance cost.

> ALSO RECOMMENDED for fluids used in electroplating. photograph finishing, textile bleaching, dyeing and finishing and heat treating of metals.

> GET COMPLETE SPECIFICATIONS from your Jenkins Valve Distributor, or write: Jenkins Bros., 100 Park Ave., New York 17. Ask for Bulletin 118.

Every part in contact with fluid is the right metal to block corrosion and beat wear.

NICKE INON

- BODIES Heavy duty, dimensioned for greater resistance to wear and abuse. Through port design in Gate Valves.
- BONNET Rugged construction, like body. Swing-type gland bolts. Screwed-In back-seating bushing. Deep stuffing
- YOKE Integral with bonnet in 2" to
- WEDGE in 10" to 24" sizes, with Stainless Steel Wedge Rings.
- · COVER in Check Valve.

Type 316 STAINLESS STEEL

- SPINDLE
- . GLAND
- . BONNET BUSHING
- . SPINDLE RING
- . WEDGE PIN
- WEDGE RINGS Rolled into Nickel Iron Wedge in 10" to 24" sizes.
- . SEAT RINGS
- . DISC and HANGER in Check Valve

NI-RESIST Type No. 2

WEDGE of I-beam structure is solid NI-RESIST in 2" to 8" sizes.

PRESSURE RATINGS

2" to 12"-200 lbs. O.W.G. 14" to 24"-150 lbs. O.W.G.

JENKIN VALVES:

CHEMICO N.E.C. PROCESS AMMONIA PLANTS

...produce one fourth
of the world's supply of
ANHYDROUS
AMMONIA

Figures show that approximately one out of every four tons of anhydrous ammonia produced in the United States—in fact, produced in the world—comes from Chemico-N.E.C. Process plants. This impressive record finds its explanation in the following five simple statements of fact.

FIRST, Chemico plants operate at 350 atmospheres, the optimum pressure for maximum economy, simplicity of design and safety in operation.

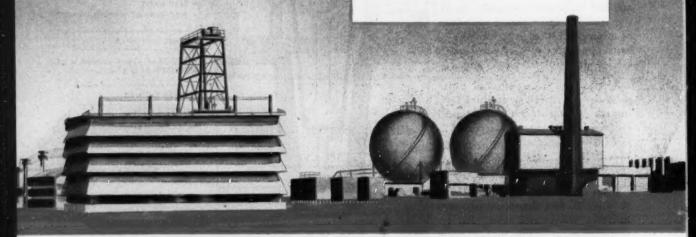
SECOND, Chemico's ammonia converter design assures perfect temperature control with resulting high conversion, long catalyst life and uninterrupted operation over long periods of time.

THIRD, modern design and complete instrumentation of Chemico's plants reduce manpower requirements, maintenance and operating costs.

FOURTH, almost thirty years of experience in this specialized field provides the background that assures the client of complete satisfaction when purchasing ammonia plants of Chemico design.

FIFTH, Chemico's interest and service extend beyond the final construction and initial operation stage. Consultation services and assistance are always available for the benefit of clients.

If you're thinking of making synthetic ammonia, or expanding present capacities, it will pay you to investigate all the advantages Chemico offers. Write today for Chemico Bulletin A-101.



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A UNIT OF AMERICAN CYANAMID COMPANY

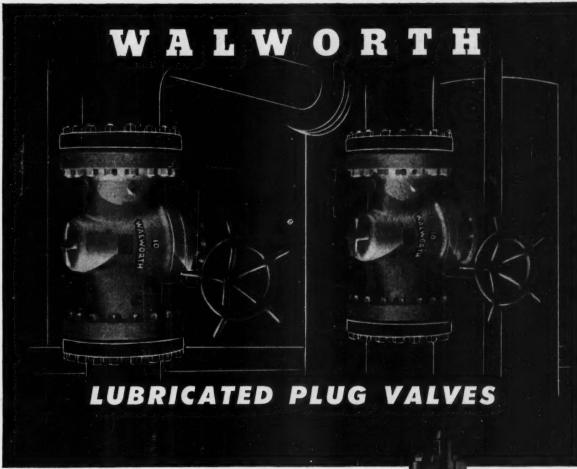
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Chemico plants are profitable investments



Better because... They are pressure sealed with an insoluble lubricant readily renewed while the valve is in service. Lubricant completely surrounds the plug ports assuring a tight seal against leaks. It also insures ease of operation by reducing friction between the body and the plug while at the same time protecting the finished surfaces against corrosion and wear.

Walworth Lubricated Plug Valves are the most satisfactory valves available for the handling of gritty suspensions, and many other destructive, erosive, and corrosive industrial and chemical solutions.

They are ideal for general refinery and pipeline service.

For full information see your Walworth Distributor, or write for your copy of Bulletin 111. Walworth Company, General Offices, 60 East 42nd Street, New York 17, N. Y.



Lubricant system of a Walworth No. 1700F Regular Gland, Wrench Operated, Steel-Iron, Lubricated Plug Valve. Other Walworth Lubricated Plug Valves include Single Gland, and Ball Bearing types. Sizes to 30-inches — pressures to 5,000 psi, and for vacuum service.

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For greatest efficiency, a Rotary Kiln must be designed specially for its job. With all the possible variations of basic kiln design, it takes an expert to tell what's best for you. With hundreds of Traylor Kilns now in operation, Traylor engineers have built up a vast reservoir of experience to draw on in building your "Traylor-Made" Kiln.

> 7 flats are needed to ship this 300' Traylor Rotary Kiln. 40 Traylor Kilns have been delivered during the past 2 years.



Primary Gyratory Crusher



Rotary Kiln



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This is the

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WHERE QUALITY BEGINS

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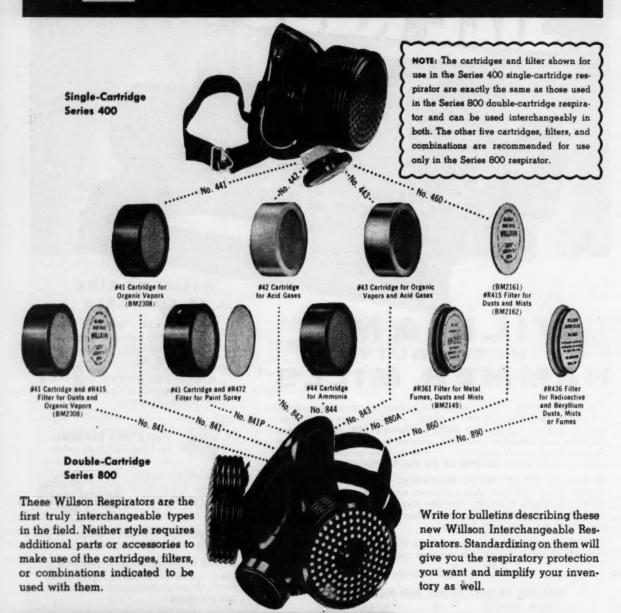
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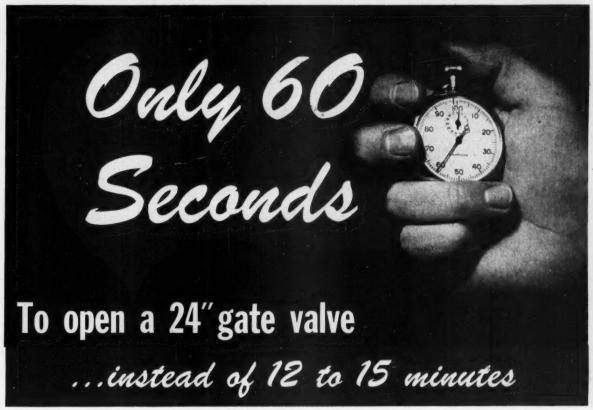
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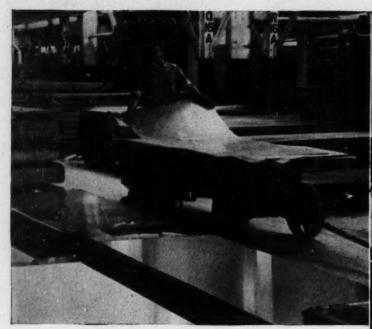


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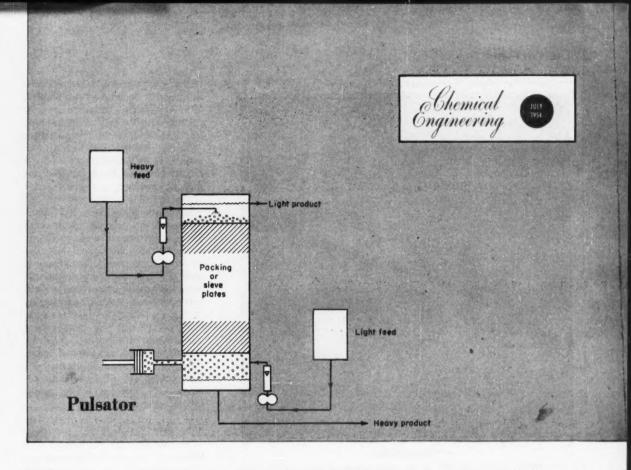
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Key to Better Extraction

Proper application of energy from an external source can speed up mass transfer in liquid-liquid extraction as much as tenfold. Here's a practical look at pulse columns—how they work, what they can do.

H. F. WIEGANDT and R. L. VON BERG

A LTHOUGH liquid-liquid extraction often can compete with fractional distillation as a means for separating materials, it has two serious inherent disadvantages.

One of these is the paradoxical fact that an extraneous component must be added to bring about the desired separation. This requires, for economy, that the added material be recovered and reused (unless it is a

Professors Wiegandt and Von Berg of Cornell University, Ithaca, N. Y., have been studying pulse columns for over five years. They were the authors of a comprehensive report on liquid-liquid extraction which appeared in Chemical Engineering in June 1952.

cheap material, such as water). There is little we can do to overcome this disadvantage.

The other disadvantage is the relatively poor performance of conventional extraction equipment. Why should an extraction tower require, say, 10 to 15 ft. of height for a theoretical stage, while a distillation column might need only 2 or 3 ft.? Why should an extraction tower be only one-fifth as effective as a dis-

tillation tower?

Chemical engineers have devoted much attention to this problem in recent years. This article sums up the progress achieved, with emphasis on one important approach to the problem—use of pulsation in extraction towers.

Turbulence Is the Key to Performance

Big reason for the disparity between performance of distillation and extraction towers lies in the degree of turbulence obtained. With no mechanical device in the tower or contactor, the only source of energy to provide turbulence is the difference in density between the two phases. Maximum energy which can theoretically be obtained from this source is small indeed; especially for an extraction column.

For example, consider a column 50 ft. high through which 1,000 gpm. of water flows countercurrently to 500 gpm. of a liquid having a specific gravity of 1.2; theoretical maximum mixing energy would be about 2 hp.

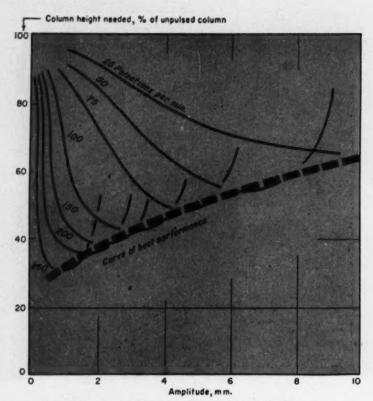


Fig. 1-PACKED column efficiency as affected by extent of pulsing.

Frequently density differences are not even this favorable. If the second liquid had a specific gravity of 0.97 instead of 1.2, the energy would be less than 0.5 hp.

When we couple this knowledge with certain other facts—that diffusional rates are much higher in gases than in liquids, distillation temperatures are usually higher than extraction temperatures, gases have low viscosities, and under boiling conditions the liquid-vapor interface is constantly being renewed—it's no wonder that the efficiency of a conventional extraction column compares so unfavorably with a distillation column.

For Better Contacting, More Energy

On the assumption that we can do little or nothing about the physical properties of the materials themselves, the only hope we have for better extraction is either to improve the amount and type of contacting per unit of energy available or to supply more energy from an external source.

In distillation operations chemical engineers have given major attention

to the development or improvement of conventional types of contacting devices, i.e., trays and packings; there has been little call for the application of external energy simply because most distillation columns perform reasonably well anyway. (For vacuum distillation, where consumption of energy in the form of pressure drop must be minimized, application of external energy might be worth investigation.)

Many Extractors Use Agitation

In extraction problems, however, efforts to get better contacting had to go beyond the search for more effective trays and packings to include the extensive use of mechanical agitation.

The mixer-settler type of extractor, using a series of vessels, is the oldest extraction device for both batch and continuous operation. Its acceptance, even today, signifies the practical importance of supplying energy for mixing the liquid phases.

For a large number of contacting stages the multivessel mixer-settler is obviously undesirable; a stacked mixersettler arrangement is a logical modification. The commonest and simplest form of stacked mixer-settler is a column—usually with doughnut-type baffles to divide it into compartments—having a central shaft which drives paddles in each or alternate compartments. However, the dispersed phase does not coalesce to give a separate phase-layer.*

Conventional packed and sieveplate extraction columns, on the other hand, suffer from the energy limitations previously mentioned. One way of overcoming these limitations is with a hybrid construction, such as using sieve plates to separate the compartments in a stacked mixer-settler, or using packing (as in the York-Scheibel column). A more radical modification of sieve-plate construction to provide added internal turbulence is the Podbielniak extractor. In this device both turbulence and separation are promoted by a rapidly rotating sieve-spiral.

Enter the Pulse Column

As you decrease the size of the holes in a sieve-plate column you get better contact, but the capacity gradually falls off until flow stops altogether. In 1935 a patent issued to Van Dijck¹¹ described a sieve-plate column that used a pulsing action to force liquids through the holes, alternately in opposite directions, thereby obtaining good capacity from a column with small holes.

Information on another column of this type is contained in a 1949 classified report by Burns, Groot and Slansky, who coined the name, "pulse column." Their column benefited not only from the use of smaller holes but also from the added turbulence imparted by the energy externally applied with a reciprocating pump.

Early in 1949, independently of prior work, the present authors began a program at Cornell University to study the use of externally applied energy as an aid in separation processes. Two of our chemical engineering students, P. C. Goundry and V. M. Romero, made the first experimental study of the use of pulsa-

^{*}In these stacked mixer-settlers the dispersed phase is not present in the same concentration from top to bottom of the column; investigation of this dispersed-phase loading as a variable in column performance would make a good research project.

tion for improving agitation in a packed column. Results were reported in Feb. 1950 via a student project report; a news story about this work appeared later in Chemical Week. The only other reported work on pulsation in packed columns is that of Feick and Anderson.

AEC Investigations

On the other hand, the Atomic Energy Commission has supported an extensive series of investigations of pulsed sieve-plate columns. Most of the published reports are classified. However, reports by the following investigators have appeared recently in the public literature: Belaga and Bigelow; Cohen and Beyer; Griffith, Jasny and Tupper; and Stephenson. A project sponsored by the Bureau of Mines has been reported by Steffanson, Higbie and Walton.

Chantry^a in a doctorate thesis reported his own work and gave a complete review of earlier work done at Cornell on both packed and sieve-plate pulsated columns. The only other thesis work that has come to our attention is that of Li at Georgia Tech.^a

Setting Up a Pulse Column

The diagram heading this article is an extraction column modified for pulse operation. If the column is packed it may be of conventional construction; if it is a sieve-plate column it must have a reasonably tight seal between the plates and the column.

To eliminate fluctuations in the meters we have found it convenient in the laboratory to break the lines between the points of flow measurement and the column. This would not be required with a positive feed arrangement. A jack-leg is frequently the easiest way to maintain the interface between liquid phases at any prescribed level.

The pulsator can take a number of different forms. Although it may be as simple as an automobile fuel pump, a piston or bellows pump with adjustable stroke, is more commonly used. A standard reciprocating steam pump is effective, particularly for larger columns. In all cases the valve arrangements must be modified, usually by removing the check valve from one port and sealing the other port.

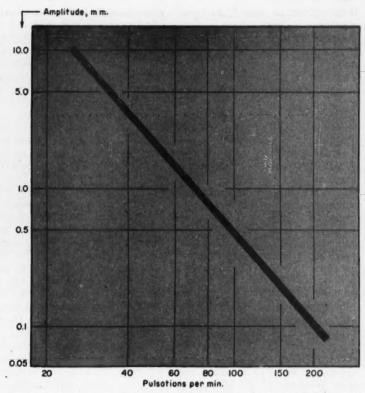


Fig. 2-ENERGY relations for pulsed packed column at 30% improvement.

What Goes On Inside

When you observe an ordinary unpulsed packed column in operation, you can see the drops of dispersed phase working their way through the continuous liquid phase and the packing. There is usually a fairly consistent pattern which shows convincingly that channeling is extensive. When you first apply pulsation, the appearance changes; you see small drops with rapid, random motion much in evidence. As the degree of pulsation is increased, either in frequency or amplitude, the confusion within the column increases, until finally the mixture becomes cloudy, and drop sizes are so small that the progress of the dispersed phase is difficult or impossible to observe.

A sieve-plate column with holes of the small size used for pulsation conditions— **a to **a in. dia., 8 to 22 percent open area—will function only with pulsing. Otherwise, the dispersed phase merely collects at the plates, and surface tension won't allow drops to pass through the small holes. (This condition is a decided advantage

during temporary shut-downs because equilibrium will not be lost in the column.)

The pulsator displaces the liquids through the plates in exactly the same volume as the displacement of the pulsator itself. This means that pulsator displacement times frequency must be equal to or greater than the maximum flow of either phase.

Here's a greatly simplified picture of what goes on inside the column:

Imagine the column with a layer of heavy liquid resting on each plate and a layer of light liquid collected under each plate. On the up stroke the displaced volume of light liquid is forced through the holes in jet streams into the heavy liquid above. On the down stroke the reverse takes place, with the heavy liquid jetting downward through the light liquid.

One might infer that this action generally maintains two distinct layers between plates. Actually, this idealized operation can be maintained only under two very limited conditions:

(1) Exactly the same volume rate of each liquid must be fed to the column.

If the volumes are unequal, the liquid supplied in the lesser volume becomes the dispersed phase, except for a thin layer which may collect at each plate during the pulsator operation. (2) There can be no significant volume change due to transfer of a component from one phase to another.

The first condition may sometimes be attainable but is not often practical. The nature of the extraction system itself determines the second condition. When the quantities of components transferred are very small (e.g., salts), there is little change in volume. More often, though, there is a considerable transfer of material and corresponding volume change. At best, it affords the possibility of establishing two nearly equal liquid layers between only a few plates.

Some Practical Considerations

In practice the sieve-plate column will not meet these ideal specifications. However, if operated with a low. enough frequency to allow coalescence after each stroke, it will approach ideal operation. Under such conditions one phase (continuous) will fill most of the space between plates; there will be a relatively small layer of the other phase. The continuous phase alone will move through the plates on one stroke, with both phases moving through the plates on the reverse stroke. Our experimental evidence leads us to believe that this relatively slow jetting and coalescence is the most efficient method of operation.

For high throughputs the frequency and displacement of the pulsator may be so great that complete coalescence between plates won't occur. This means that both continuous and dispersed phases move back and forth through the plates, the plates acting as a resistance to the flow. Hence the action is much like that of a packed column, except that parts of the column are open.

For reasonably high throughput rates, therefore, the column really functions as a modified packed column. Thus, there should be considerable advantage with conventional systems in spacing the plates close enough together to achieve the effect of a modified packing. More work should be done, too, on a direct comparison with feasible types of packing.

Performance of Packed Pulse Columns

In considering performance data for pulse columns, let's consider the two types, packed and sieve-plate, separately. Data for packed pulse columns are more consistent and can be compared directly with data for the same columns without pulsation. On the other hand, sieve-plate data have been very difficult to correlate, and there is no comparable information for the same columns without agitation.

Fig. 1 shows the performance of packed pulse columns; it is based principally on work done at Cornell University using small-diameter colums with ‡-in. Raschig ring packing. Amplitudes refer to movement in the unpacked section. These data extrapolate reasonably well to the high-frequency data of Feick and Anderson using different systems. The dashed curve drawn through the minimum points of each constant-frequency curve relates the optimum frequency and amplitude.

Any particular system will probably deviate from this generalized plot because of differences in diffusion rates, interfacial tensions, densities, etc., but Fig. 1 should give a good estimate of what to expect. Performance of different packings will no doubt deviate from these curves also, the more open

the packing the greater the contribution from a pulse action. Open packings would require higher turbulence, however, to obtain these results.

These curves are drawn for a column operating at reasonable loading conditions (60 percent of flooding rateon the unpulsed basis) and at about equal flow of the two phases. On thisbasis a better-than-three-fold improvement over the unpulsed column isobtainable.

Performance of a pulse column is practically independent of the continuous-phase flow rate. While a change in the flow rate of the dispersed phase has some effect on a pulse column, its effect is much greater with a conventional column. With low dispersed-phase flow rates an ordinary extraction column has poor efficiency; in this operating range pulsing will show improvements of 10-to 15-fold. In such instances hold-up of the dispersed phase may increase from, for example, 5 percent (unpulsed) to 50 percent or more (pulsed).

As operating conditions approach flooding, pulsation gives the least improvement. This is because turbulence is already good under these conditions

We see, therefore, that pulsation allows efficient operation of an extraction column in a region of feed rates where, ordinarily, extraction efficiency is poor. We can get flexibility of operation by adjusting the pulsator to an optimum operating condition irrespective of feed rates or ratios.

Packed Column Mechanism

Here's a picture of the mechanism of pulsation in a packed column:

At low degrees of turbulence the dispersed phase is well mixed and distributed so that we get good contact between phases and little channeling. As we increase the intensity of agitation the droplets break up more often and into smaller droplets. These, in turn, coalesce with other droplets they hit and then break up again. This action results in excellent mass transfer, reaching a maximum at a specific degree of turbulence.

Past this point the emulsion becomes more stable, with smaller particles formed, less coalescence and redispersion, and some carry-over of dispersed phase; extraction is now less

Who's Using Pulse Columns?

Extent of pulse column usage in atomic energy plans is still classified information. Among chemical firms, Shell, Dow, Monsanto, Merck and Hercules have all been interested in pulse columns, although none of them report any largescale use as yet.

In the laboratory, Dow found that HETS of a 2-in.-dia. unpulsed column could be reduced from 45 in. to 5 in. by pulsing. This was a "rather difficult" separation involving a viscous solvent. Merck reports that a lab column showed a three-fold improvement in efficiency.

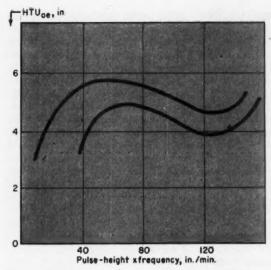


Fig. 3-PERFORMANCE of a sieve-plate pulsed column.

B Reciprocating steam pump.

Fig. 4-PULSE patterns used in extraction work.

efficient. Finally we reach the flooding point. In general this mechanism explains the definite minima in the constant-frequency curves.

We believe that coalescence and redispersion of the droplets and complete elimination of channeling play more important parts than does the increased transfer area due to better dispersion. Because an extreme increase in diffusion rate from the droplet is possible, the liquid in which the diffusion rate of the solute is the poorer should be the dispersed phase. Thus the choice of which phase is to be dispersed may be more important for a pulse column than for standard packed columns. Fortunately, there may be more freedom to make this choice in the pulsed system, whereas it is quite often fixed by wetting properties, interfacial tensions, etc., in ordinary extraction equipment.

Conceivably, plotting as abscissa some function of power input (such as frequency × amplitude) could eliminate the frequency parameter and give a single-line correlation of the efficiency of pulsation in a packed column. We were unable to obtain such a simple plot. The type of relationship obtained between frequency and amplitude at a fixed improvement factor is shown in Fig. 2. This yields an equation of the type, amplitude × frequency = a constant. This relationship, although approximate, does indicate the inadequacy of considering

power input alone as a measure of expected improvement.

Performance of Sieve-Plate Columns

The behavior of a sieve-plate column is much more difficult to portray in a single graph. This is because the data available are based on columns which vary in hole sizes, open areas, plate spacings, etc., and in methods of operation, such as the opposite extremes of ideal layer-formation and operation approaching that of a packed column.

Belaga and Bigelow made an attempt to correlate a considerable amount of data obtained by AEC investigators. All the sieve-plate columns used had 0.04-in. holes, 23 percent hole area and plates 1 or 2 in. apart. The range of operating conditions was 1 to 2 in. in amplitude and 20 to 80 cycles per min. in frequency. The correlation obtained was a rather broad band (see Fig. 3).

A fairly reasonable explanation of this curve can be given. In the region of high efficiency and low amplitude × frequency the column is operating with the ideal two layers between plates. This gives the lowest HETS* in the cases analyzed. (The actual values of HETS in this region are roughly the same as those for a small pulsed packed column—1 to 2 in. dia., 4-in. Raschig rings.) As amplitude ×

frequency is increased, complete coalescence after each pulse is impossible; time of contact is shorter, and column efficiency decreases (HETS increases). However, as amplitude × frequency is increased still further, no layers at all are formed, and the column is functioning as a packed column. As in the packed column plot, there is an optimum point of operation. Finally, agitation is so vigorous that a stable emulsion results and the column approaches flooding.

Griffith, Jasny and Tupper' obtained data in the range of vigorous agitation. They were able to show several constant-frequency curves that suggest a family of the type in Fig. 1. Li* found that at low frequencies and large amplitudes, performance was unimpressive. His column may have been operating like a packed column at higher amplitudes. The HETS values of Cohen and Beyer (10 to 20 in.) and similar values by Steffanson, Higbie and Walton may also represent combinations of frequencies and amplitudes greater than optimum. Although these data are widely scattered, indications are, however, that for sieveplate columns with 1-in. and 2-in. plate spacing the optimum amplitude for any given frequency is greater than for a packed column.

Available data show that the most practical operating range of a pulsated sieve-plate column is in the region where its action approaches that of a

Height equivalent to a theoretical stage.

packed column. There are several reasons for this. One is that very seldom do all conditions of operation combine to get ideal two-layer operation. Another is that reasonable throughput rates require operation at fairly high amplitude × frequency values. This is because the rate of pumping liquid through the column is limited by the pulsator displacement, or amplitude × frequency.

As suggested earlier, if a sieve-plate column is operated as a modified packed column it should be more efficient with closely spaced plates. Unfortunately, no data are available on plate spacings less than 1 in. By furnishing more resistance to flow, close spacings would give better turbulence. Another important effect would be the reduction in back-mixing and shortcircuiting because of the greater number of compartments in the column. Needed, however, would be the proper type of pulsing-small amplitude and high frequency.

Design Factors for Pulse Columns

Small packed columns have demonstrated capacities in the range of 20-30 cu. ft. per (sq. ft.) (hr.) combined flows with ceramic packing and 40-60 with mesh packing. This represents 60 to 90 percent of nonpulse flooding conditions for ceramic packing and almost 100 percent for mesh packing. Sieve-plate construction allows a flow of 30-100 cu. ft. per (sq. ft.) (hr.), which can be considered reasonable for conventional sieve-plate columns. In any case the flow rate can be no greater than emulsification conditions will allow; a system on the borderline of emulsification cannot be pulsed at

Scale-up factors in going to a 20-in. column have been found in one instance to be of the same magnitude as those for conventional packed columns. Because pulsing reduces channeling, a large-diameter column should have the same extraction efficiency as a small one, if the same size packing is used in both columns. However, economic considerations generally dictate the use of larger packing, so conventional scale-up factors must be considered. Pulse conditions must be modified for larger packing. Not enough work has been done along this line to establish how amplitude and

frequency should be changed, but the factor is much smaller than the ratio of packing sizes.

All information available indicates that pulsed sieve-plate columns can be scaled-up directly; this is a decided advantage in some work.

Power consumption for pumping is insignificant. In larger equipment it is about the same as for feed pumps. Reduced column height even offsets this extra power to some extent. A hydraulic balance-leg on the pulsator will save some power but is probably not justified.

Compared with most plant modification jobs, installation of a pulsator on an existing extraction column is simple. A plant-scale packed column usually has several available openings of suitable size; perhaps the bottom feed line is big enough, there may be observation ports, or a manhole plate may be fitted for pipe connections. Before this is done, however, you must evaluate the system of components, particularly with respect to emulsion formation. For sieve-plate operation the liquids should be very clean to avoid plugging the column.

Packed Versus Sieve-Plate Columns

In comparing the two types of columns, the chief advantage of the pulsed packed column is that it represents a modification of standard equipment, whereas the design of a pulsed sieve-plate column is special. Also, dirty and corrosive solutions can be handled much better in packed col-

On the other hand, sieve-plate columns probably have higher throughputs and lower HETS's. (There are no comparative data to prove this statement.) As a laboratory tool, the sieveplate column has a decided advantage in that it can be stopped and started again without materially disturbing the equilibrium throughout the col-

Both types, of course, have the disadvantage that systems easily emulsified can allow only a slight turbulence induced by pulsation. In these instances little improvement in extraction efficiency can be obtained.

Future Investigations

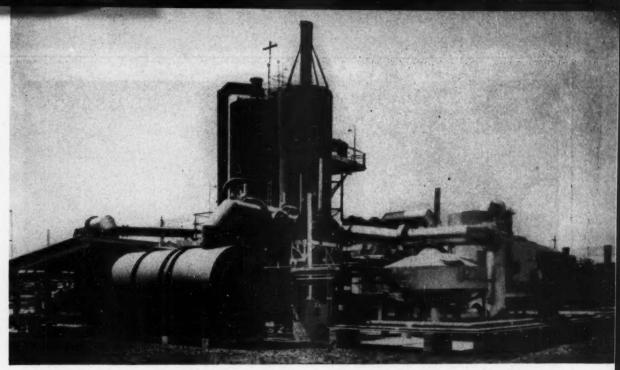
Many other developments in pulse extraction are in progress. Sintered

metal plates separated by gaskets, diatomaceous earth, silica gel, ionexchange resins, and other materials of high surface area are being considered as column packing materials. In each instance action at the interface as a result of preferential wetting, preferential displacement and mechanical shear can be expected under conditions which in porous structures will be laminar flow. Although this is in the direction of reduced bulk turbulence, it still involves the introduction of energy to obtain high shear. This combination points in the direction of handling easily emulsifiable systems.

Fig. 4 represents various types of pulse patterns. Almost all work to date has been done with pumps operated through a conventional eccentric as in A. B is the type of stroke obtained from a double-acting steam pump. An example of a possible pattern when using a cam drive is shown in C. Work that has been done on pulsewave patterns indicates that variation in pattern has little effect on extraction efficiency, except at very low frequencies. However, a special pulse pattern, such as a slow movement in one direction and a fast movement in the other, may be a means of handling systems in which the phases are of almost equal density.

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METALLIZING of steel areas exposed to rust scaling is standard practice in Chemico contact sulfuric plants such as the one above.

Metallizing May Be for You

Check the following examples of successful applications to get a perspective of this important means of corrosion prevention. Metallizing systems (metallic coatings plus organics) are extending its uses.

HOWARD VANDERPOOL

Metallizing is frequently associated with the building up of worn machine parts to fit them for re-use. But there is another very important use of metallizing that is of more direct interest to the chemical engineer, and this has to do with protective coatings for process equipment. These coatings are sprayed metallic coatings which may be supplemented with organic coatings to form what is known as metallizing systems. Metallic coatings and metallizing systems can do three things: (1) protect the base metal from corrosion, (2) prevent product contamination, and (3) help minimize equipment down-time.

There are many situations in chemical processing which lend themselves to the economical application of metallizing. The following examples will

HOWARD VANDERPOOL is application engineer for the Metallizing Engineering Co., Long Island City, N. Y. give you a perspective as to what it can do for you.

In Contact Plants . . .

Designers and users of contact sulfuric acid plants have found that metallizing with pure aluminum is the answer to a very serious problem. A rather unique situation exists here. Metallizing is not used for the purpose of avoiding product contamination or even to preserve mild steel.

At the points metallized, steel is exposed to temperatures ranging from around 450 to as high as 625 deg. C. Passing through these portions of the plant is a gas containing varying amounts of SO₂ and SO₃. Without metallizing, the mild steel tends to scale. While this is not at all serious from the point of view of converter life, some scale falls off and drops onto the surface of the catalyst. This catalyst is in the form of small pellets, and large pieces of scale lying on top of

the catalyst bed (or small pieces which become mixed with the catalyst) tend to increase resistance to gas flow through the equipment. Only 0.010 in. of aluminum very materially reduces the scaling.

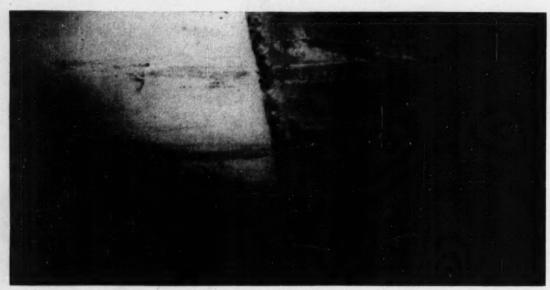
Apparently the best protection is provided by following this procedure:

1. Blast with angular grit, clean and sharp. Mesh size of SAEG-25 to G-40 shall be used. All surfaces shall be thoroughly cleaned.

2. A bonding coat of low carbon steel shall be applied to the freshlyblasted area by a wire-type metallizing gun to a thickness of approx. 0.601 in.

3. Aluminum shall be applied to this freshly-sprayed surface to a thickness of approximately 0.010 in. The (Continued on page 193)

FOR: 1. What Metallizing
Is . . .
2. How It Works . . .
TURN PAGE



SUCCESSFUL APPLICATION of metallizing at left-hand portion of this steel plate. Right: no metallizing. Note rust.

Metallizing: What It Is, How It Works . . .

Application of non-corrosive metallic coatings on structural iron and steel is perhaps the second most important means of corrosion mitigation, the first being the application of organic films.

Hot dip galvanizing is well established. Hot dip coatings of aluminum are coming into use more each day. Other materials such as stainless steel, nickel, Monel, copper and lead can be applied by various methods although these materials have not been used to as great an extent.

Metallizing is the method of applying metallic coatings by spraying. Unlike hot dipping and plating, sprayed metals can be applied in the shop or in the field. New structures can be coated before erection and existing structures can be treated after a considerable amount of attack has taken place. As with other methods of applying metals, such as plating and dipping, zinc and aluminum are used most.

METALLIZING SYSTEMS

More recent development in the metallizing industry is the use of newly-developed organic coatings in conjunction with metallic coatings. Organics such as vinyls, epoxys and phenolics—although having very good chemical resistance—do not have the wetability, penetration and adhesion that the less chemically-resistant oleoresins have.

There is perhaps no better base for any paint than a thin coating of sprayed metal. The sandpaper finish of sprayed metal containing microscopic voids and irregularities presents a perfect surface for organic coatings.

No one system of corrosion prevention can solve all of the corrosion engineer's problems. However, a combination of two systems can do much to approach this ideal condition. In pipe line work, it is well known that a combination of organic coatings plus cathodic protection provides the best means of protection. Metallizing systems (sprayed metals plus organic materials), provide a similar means of licking tough problems.

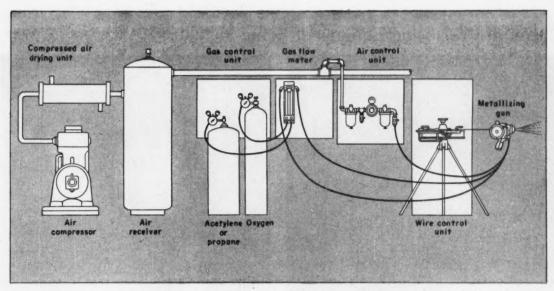
POROSITY CONSIDERED

Sprayed metal tends to be porous. Porous paint is little better than no paint—but porous zinc on lock gates of the St. Denis Canal, Paris, has prevented rust for over thirty years. Porous aluminum on the interior of a contact sulphuric acid plant eliminates rust scaling in a highly corrosive environment. Reason: cathodic protection afforded by the zinc and aluminum makes it possible for the base metal to be protected in spite of porosity. According to the electrolytic theory of corrosion, steel cannot corrode in the presence of anodic metals electrically connected. Hence the zinc and aluminum act as sacrificial coatings.

HOW METALLIZING WORKS

In a conventional metallizing gun, metal in wire form is fed through a gas-oxygen flame into a stream of high velocity air. The flame melts the metal while the air atomizes it and drives it into a prepared surface.

Corrosion work generally calls for blasting of steel with a sharp abrasive. Round shot or seashore sand is not satisfactory. Molten metal takes the form of small particles, probably round. Upon contact, it impacts itself into the rough surface of the blasted steel. Surface of the resulting coat is sufficiently rough to receive successive coats of metal. Particles are small. This low mass



EQUIPMENT for metallizing. Metal in wire form is fed through a gas-oxygen flame into a stream of high-velocity air.

accounts for the fast release of heat and solidification of the metal. Build-up is continuous.

Oxides in various forms are included in this mechanical structure of platlettes of pure metal. Microscopic voids exist. Corrosive liquids can under certain conditions penetrate the film. Whether or not corrosion of the base metal results depends upon other factors.

Heavier coatings can effectively overcome porosity. Cold or hot working of the surface can seal or densify the sprayed metal. Some metallizing systems involve a heat treatment, which results in fusion within the coating and of the coating to the steel base.

ORGANICS FOR ADDED PROTECTION

Organic materials are an important means of sealing metallized coatings. Vinyls, chlorinated rubbers, linseed oil, waxes and silicone-base resins are typical types.

Organic coatings used without metallizing must have a multitude of characteristics to provide a satisfactory protective film. Some of these are:

- 1. Resistance to the corrosive.
- 2. Resistance to low and high temperatures, as well as changes in temperatures.
 - 3. High film strength.
 - 4. Good adhesion.
 - 5. Ability to take subsequent coatings.
 - 6. Ability to cover evenly.
 - 7. Resistance to abrasion.

This is a large order and is farely found in one material. Many paints, however, possess one or more of these characteristics. For instance, several new organics have unusually high chemical resistance but are lacking in adhesion, resistance to actinic rays of the sun and resistance to abrasion.

Need for all these qualities is eliminated when organic coatings are used with metallizing. They need only be chemically stable to seal the pores of the sprayed metal. It is generally accepted that the life of any good paint can be tripled when it is applied to metallized steel. What is more pertinent, the life of metallizing is extended by the use of a relatively inexpensive film.

As the organic material may in time weather or oxidize, successive coats can be applied but there is no rust or loss of steel beneath the zinc. Instead of expensive chipping, wire brushing and spot priming, only re-application of paint is needed—and then only at extended periods.

It should not be taken that this sealing procedure is always necessary. Actually the vast majority of work done in the past has used only the pure sprayed metal with outstanding success. As a result of 20 years' experience and the recent development of chemically inactive plastic paints, sprayed metal plus sealers for longer and more intensive protection are being specified.

WHAT ABOUT STAINLESS, NICKEL?

Thus far we have only discussed zinc and aluminum, the metals that confer cathodic protection. Stainless steels, Monel, nickel, silver and in fact almost any metal can be sprayed.

The important thing to remember is that porosity is a much greater factor with these metals. They do not possess the electrolytic protection qualities of zinc and aluminum, hence, will not protect at voids.

, In spite of this situation, chemical plants benefit from the use of cathodic metals in the sprayed form as protection for steel tanks, structures and process equipment. Sealers are used and other factors (such as heavier coatings, cold or hot working of the surface) act to offset porosity. The products of initial corrosion are generally resistant to the corrosive. For this reason, the coatings are often self-sealing.

Chemical Processing Equipment Being Metallized . . .

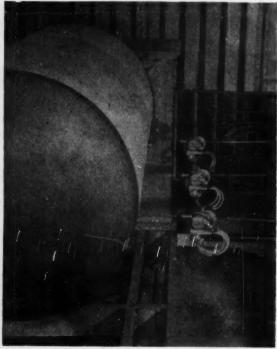


PULP DIGESTER interior being metallized with 18-8 stainless steel to prevent replacement of plates lost through corrosion. FILTER MASH TANK being metallized with 0.010 in. of zinc to prevent corrosion and minimize abrasion of the base metal.





GLYCERINE STORAGE TANK being metallized. Inside coating prevents contamination, outside coating prevents corrosion. STEEL COVERS subjected to hi-temp, and sulfur compounds being metallized with aluminum. Work is on a production basis.



METALLIZING (starts on p. 189)

aluminum wire used in this operation shall be of 99.0 percent purity or a silicate aluminum containing 4.5 to 6 percent silicate.

4. An organic finish coat shall be applied consisting of a silicone resin base, aluminum-pigmented paint. This shall be applied in two coats, the first coat being thinned down to form a very wet surface. This provides for penetration of the material into the porous surface of the aluminum.

The organic material is not entirely necessary. However, as has been indicated on work of this type for the past five years, it does not add materially to the total cost of the job and it does add considerably to the life of the coating.

Using Composite Coatings . . .

Sometimes composite coatings of metals are applied to solve unusual problems. The Stauffer Chemical Co. has a chloro-organic acid unit in which an exhaust fan is used to convey very corrosive gases in the operation of a column. The gas is anhydrous hydrogen chloride contaminating chloro-organic acid compounds at a temperature of about 20 deg. C.

Originally this exhauster was designed with a wheel and shaft of stainless steel. Various coatings were tried in an effort to find something that would provide protection for more than two to four months on the housing and four to six weeks on the wheel. It was known that silver suffered very little from attack or penetration by the gases. It was decided to test with silver as metallized. Corrosion engineers recommended the following:

1. Blast preparation.

2. 0.005 in. of molybdenum (for bonding purposes).

3. 0.020 in. of nickel.

4. 0.025 in. of pure silver.

The unusually heavy thicknesses were to overcome porosity. Both wheel and housing treated in this manner have now been in operation well over a year with no signs of serious corrosion. The metallizing work paid for itself in three months and down-time was materially reduced.

On the same piece of equipment, a chrome-nickel-manganese alloy in the packing gland section had suffered considerable abrasion. Tantalum was selected and applied by the metallizing method. This procedure has increased shaft life at the gland at least five times.

For Atomic Project . . .

Du Pont has written specifications for zinc spraying of steel for the Savannah River Plant. This covers exact procedures for the application of approximately 0.006 in. of zinc to sand-blasted and prepared ferrous metal structures. Naturally, the actual applications for this protection are classified. However, the nature of the metallizing system indicates that it is for protection of steel structures such as gates, valves, penstocks or similar equipment exposed to normal or industrial atmospheres, or fresh or polluted waters.

In general, on this type of work, coatings are applied for an anticipated life of at least ten years. This of course would be without additional treatment or maintenance.

With Glass-Lined Steel . . .

Use of glass-lined tanks in the chemical and food industry has enabled manufacturers of these products to handle intensely corrosive liquids. Two problems are involved here: (1) actual corrosion and loss of the steel, and (2) product contamination. Glass equipment, however, is occasionally subject to cracking and chipping. Calco, Du Pont and several large brewing companies have found that metallizing is an economical and long-lasting method of mending chipped glass.

At one time, involved procedures were used—including the drilling of holes and placing of gold and other noble metal plugs in these holes. Some success has been discovered with organic cements. Ceramic cements have also been used. None of these seem to be as successful as the use of metallizing equipment in spraying noble metals over the areas which have become perforated.

In the brewery industry, tin seems to be the metal most used. The chemical manufacturers on the other hand find that gold, platinum, molybdenum and similar metals provide very satisfactory results. Naturally, the environment must be considered before selection of sprayed metal is made.

Procedures vary, but essentially they are as follows:

A small "cemetary type" sand blast generator is used to prepare the affected area. It is necessary that all of the loose glass and corroded steel beneath is removed. Before contamination or oxidation takes place, this area is completely metallized to a thickness necessary to avoid porosity of the sprayed metal. In some cases this sprayed metal is then wire brushed with a suitable wheel. In other cases, an organic sealing compound is used over the sprayed metal.

In Breweries . . .

Storage and handling of malt syrup in breweries presents a problem which can be solved by the use of metallizing systems.

Specifically, we refer to the use of pure sprayed aluminum followed by a vinyl treatment. This system will provide a finished coating having a light gray color with a high gloss. This of course is desirable where food products are handled and frequent cleaning is necessary.

The three-step procedure:

1. Blast preparation.

- 2. Metallized aluminum coating to 0.008 in. thick.
 - 3. Two coats of a clear vinyl.

To Prevent Scaling . . .

An eastern chemical manufacturer used metallizing experimentally over six years ago to prevent rust scaling on the interior of drying ovens. Temperatures involved here go to 800 deg. F. So far, the coating is satisfactory. If this work were to be repeated today, the specification would be 0.010 in. of metallized aluminum plus a silicone-base aluminum-pigmented paint.

With Fatty Acids . . .

In the storing and handling of certain types of fatty acids used in the soap and food industries, aluminum coatings on steel surfaces have effectively contributed to the reduction of product contamination. Tendency in this work is toward heavier coatings of aluminum due to the fact that cathodic protection resulting from the aluminum-steel potential difference is not particularly effective. The protection here apparently results from the fact that aluminum in itself resists the

formation of corrosion products. In other words, here we must provide a barrier of aluminum which is essentially impervious to the solution.

In glycerine handling, it is standard practice to use zinc metallizing to prevent product contamination in rail tank cars.

For Water Tanks . . .

Water tanks, particularly the elevated types, were first metallized in the early 1930's. This treatment is established now as a "permanent" means of corrosion prevention. Here we have an instance of cathodic protection by metallizing. The action of zinc or magnesium anodes or impressed currents from outside sources is well known in water tank work. When a steel surface is sprayed with zinc 0.010 in. thick, a barrier action is set up by self-sealing. If, at a future date, areas of steel are exposed by rising and falling ice-the remaining zinc provides cathodic protection. Further, because zinc is applied to surfaces above the water line as well. complete protection is a result.

For Pulp Digesters . . .

Congoleum Nairn in their plant at Cedarhurst, Md. used metallizing in the interiors of pulp digesters. They save roughly \$8,900 in addition to three weeks down-time every three years. The plant engineer reports that the cost is approximately \$800 to spray the entire inner surface with 0.010 in. of an 18-8 stainless steel.

With Galvanized Steel . . .

When Du Pont's Victoria, Tex. plant was built, extensive use was made of hot-dipped galvanized steel. All welds, as well as chipped areas of galvanizing, were metallized. This resulted in a continuous coating of zinc over all exposed steel.

An interesting note here is that blasting was not used but the work was heated to provide a bond. Specifically, they first removed all slag and then thoroughly wire-brushed the welds. Heat was applied, elevating the surface to about 500 deg. F. A quick brush made it ready for a good coat of zinc.

Although this method is often used successfully, it is discouraged due to the difficulty in getting a quality operation. Unless excellent workmanship is assured, failure will be likely.

Dow at Freeport, Tex. accomplished the same protection using conventional blasting.

This type of work protects in two ways. First it replaces zinc lost due to the welding operation. Then, by applying 0.010 in. of zinc, additional protection is provided at the point where corrosion is most likely to get its start.

The same Dow plant uses a nickelchrome alloy metallizing to protect steel magnesium melting pots from heat oxidation.

Actual Metallizing	Costs	
Equipment	Metallized With	Cost, \$/Sq. Ft.
Sulphuric acid converter	Al	\$1.35
Elevated water storage tank interior.	Zn	1.65
Ship cargo tank, mixed chemicals	Zn	1.95
Rail tank car, glycerine	Zn	1.35
Hot exhaust stack, 1,000°F	AI .	1.20
Tank exterior, industrial atmosphere		0.90

What About Costs for Metallizing?

Metallizing costs are high. On the other hand, benefits from increased protection often make it an economical choice. This is especially true when the cost of equipment downtime is considered.

Actual metallizing costs are here explained. A basic figure of 2 c. per thousandth of an inch per sq. ft. is often used in computing metallizing costs. This is not, by any stretch of the imagination, the total cost of any metallizing work in chemical plants. It is useful only as a starting point for computations. It represents roughly the time and material involved in coating a flat surface 0.010 in. thick with zinc or aluminum. The following factors must be added:

1. Preparation, usually abrasive blasting. This varies with the condition of the steel.

2. Overhead, supervision, helpers, insurance, available working hours out of twenty-four, extra labor resulting from district labor regulations.

Scaffolding and other preparation due to accessibility and location of the work.

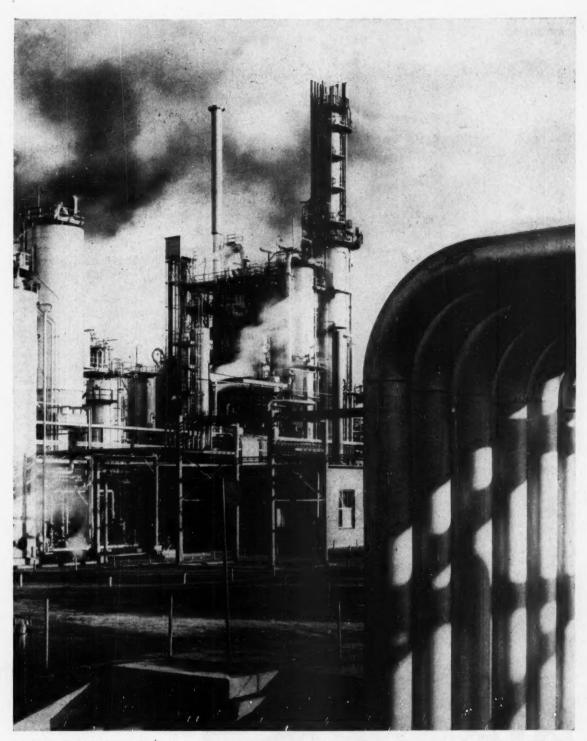
4. Edge loss, due to angles and round surfaces.

Perhaps the most commonly used method of computing costs is that of comparing the work in question with other completed jobs which are similar in nature. All the figures in the above table are factual and are used because they are representative of work done by contractors. Further, in all cases, these jobs were economically justified.

These costs are not in any way standard. Engineering assistance is available for the purpose of computing costs based on recommended systems. Naturally 0.003 in. of zinc with two coats of a vinyl will cost less than 0.012 in. of aluminum with a fourcoat vinyl system.

When this work is performed during construction and sections such as bulkheads are done before assembly, the price per square foot is materially reduced. When such work is done, areas to be welded are often left uncoated and done after assembly. Naturally, this decreases the scaffolding costs and cost of blast sand removal.

Basic recommendations should be obtained prior to initial consideration of metallizing in chemical plants. Most authoritative material along these lines is "Recommended Practices for Metallizing." These practices have been compiled by the Metallizing Committee of the American Welding Society, and can be obtained from the American Welding Society, 33 W. 39th St., New York 18, N. Y.

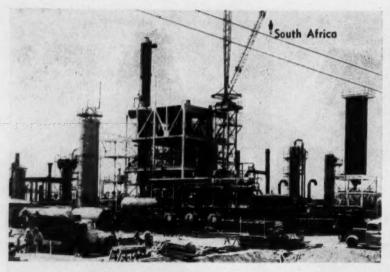


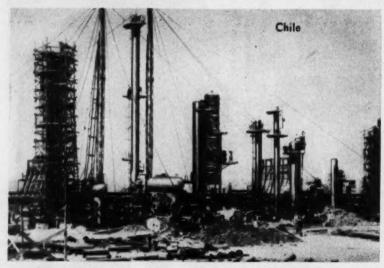
IN WEST GERMANY and all over the world, increased emphasis on refining of both coal gases and petroleum evidence that . .

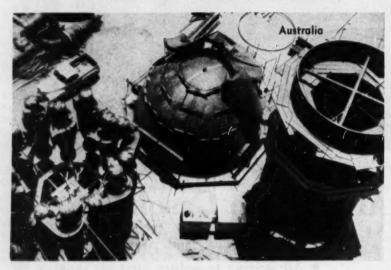
Everybody's After More Gasoline

- Europe, Africa, South America, Australia
- All striving to bolster local oil supplies







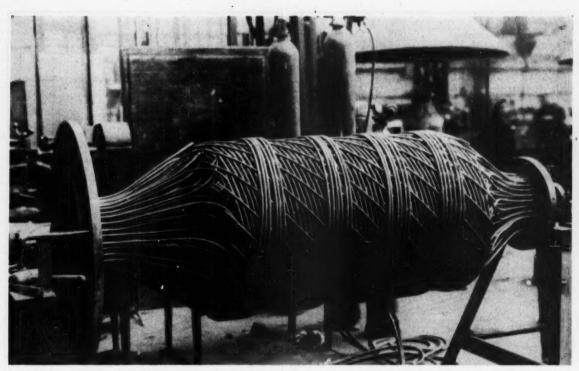


► West Germany—Almost totally destroyed during World War II, the Hamburg refinery of Esso A. G., a Standard Oil Co. (N. J.) affiliate, has been rebuilt and is now back on stream at triple its prewar capacity (page 195). Expansion and modernization cost \$12 million, all of which came from private capital sources. The plant's crude capacity is 37,000 barrels per day and combined catalytic and thermal cracking units are being used to make a full line of fuels, lubricants and asphalt products.

▶ South Africa—Located in a country that lacks major petroleum deposits, the South African Coal, Oil and Gas Corp., has turned to coal as a source of oil products. Its new plant near Johannesburg is just starting limited operations. Heart of the process is M. W. Kellogg's Synthol process for catalytic reaction of gases from coal combustion (left). When completed, probably late in 1955, annual output will be 55 million gallons of gasoline, plus 16 million gallons of fuel oils and industrial chemicals.

▶ Chile—An important addition to South America's economy, Chile's first oil refinery, rapidly taking shape near Valparaiso, will process both native and imported crudes. Planned capacity is 20,000 barrels per day and will be comprised of atmospheric distillation, vis-breaking, thermal reforming and thermal cracking units for production of liquified petroleum gases, gasoline, kerosene, diesel oil and heavy fuel oil. Design and engineering is by M. W. Kellogg Co. for Empressa Nacional del Petroleo.

► Australia – Being built to supply nearly half of Australia's petroleum needs, Anglo-Iranian Oil Co.'s 70,000 barrel per day integrated refinery near Freemantle is more than 30% completed. It will be the country's first major oil processing unit. Included are two 35,000 bpd. crude distillation units and a 12,500 bpd. Model B Orthoflow fluid cat cracker (left). Also under construction are a 1,700 ft. precast concrete jetty to accommodate ocean going tankers and a 17 mile products pipeline to Freemantle.



Coiled tubular exchanger designed for heat transfer through liquefied gases, a working example of . .

How to Design for Low Temperatures

In gas processing at low temperatures, heat transfer problems assume major importance. Commercial success may hinge on the skill exercised in designing the exchangers. Let us help you sharpen your skill

R. J. SWEENEY

As refinery waste gas streams become the raw materials for petrochemical production, we note increasing interest in low-temperature gas separation processes.

Past experience with air separation

R. J. Sweeney, consulting engineer of R. J. Sweeney Associates, Catasauqua, Pa., has specialized in power plants, heat transfer and thermodynamics. But he is an engineer of wide and varied experience. He has been a teacher and the director of a research laboratory. More recently he is responsible for the design of many low-temperature gas processes.

and hydrogen purification emphasizes that heat exchanger costs loom large in the over-all picture. High temperature differences in exchangers — particularly at low temperatures—result in high compression power costs for the necessary refrigeration.

Ideally we want to have as small a temperature difference as possible along the exchanger. It's really the transfer of cold that we are concerned with, and the production of cold costs money. Design practices in this field have usually been based on previous experience. This approach fails when radically new processes are proposed.

The designer must dig into the

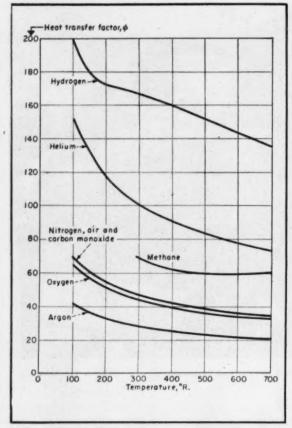
fundamental theory for his guidance. We've tried to summarize these fundamentals for you. And then we've tried to set up design procedures for the various phases of heat transfer that you'll encounter.

The material available is by no means complete so that educated guessing is required to get approximate answers. But at least here's a jumping-off point.

DRY GAS IN TUBES

Standard texts give us a generalized relation for heat transfer inside tubes:

 $Nu = 0.023(Re)^{0.8}(Pr)^{0.3}$ (1)



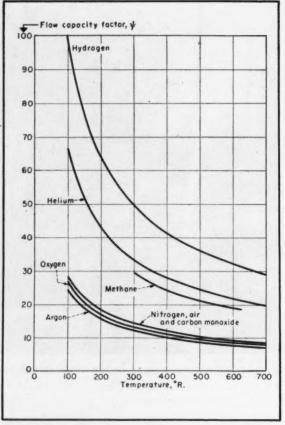


Fig. 1-Relative heat transfer of dry low-pressure gas in tubes. Fig. 2-Relative flow capacity of low-pressure gas in tubes.

where the dimensionless groups are,

Nu = hD/k, Nusselt number $Re = DG/\mu$, Reynolds number $Pr = c_p \mu/k$, Prandtl number

For the common diatomic gases the Prandtl number can be assumed constant at 0.74, independent of temperature and pressure. Using this simplification:

$$h = 0.0293c_pG^{0.8}(\mu/D)^{0.2}$$
 (2)

It is desirable to correlate heat transfer with pressure drop for design purposes. The general expression for pressure drop in tubes is:

$$\Delta P = fG^{2}AL/2g\rho D \qquad (3)$$

In the range of Reynolds number from 5,000 to 200,000, the friction factor, f, can be approximated by

$$f = 0.046/Re^{0.2}$$
 (4)

and the density, p, for low pressure gases can be taken as the perfect gas value,

$$\rho = MP/RT \tag{5}$$

Now we solve both the heat transfer and pressure drop expressions for the

mass velocity, G, equate the two mass velocities and solve again for the film coefficient,

> $h = 22.2c_{y} \mu^{0.111} D^{0.334} b^{0.446}$ (6)

where,

 $b = MP \Delta P/LT$

The viscosity factor can be evaluated by Jean's formula:

$$\mu = \mu_0 (T/T_0)^n \tag{7}$$

Now we can throw the temperaturedependent factors into a temperature function, ϕ , for each particular gas.

$$\phi = 22.2c_p \mu^{0.111} (M/T)^{0.445}$$
 (8)

$$h = \phi d^{0.384} (p \Delta p/L)^{0.448}$$
 (9)

$$h = \phi d^{0.334} (p \Delta p/L)^{0.445}$$

We have plotted the coefficient φ in Fig. 1 for a number of common gases. In Eq. (9), the diameter is in inches, p and Ap are in psia. and L is in ft. Then units of the film coefficient, h, are Btu./sq. ft.-hr.-deg.

Looking at Fig. 1, we see that the curves for nitrogen, oxygen, carbon monoxide and air show the normal pattern for diatomic gases. The heat transfer is improved at low temperatures principally due to the increase in density, with a mild assist from reduced viscosity. Argon follows the same pattern with lower values, because of its high molecular weight and low monatomic specific heat.

Hydrogen is very high, due to its low molecular weight. The peculiar shape of the curve can be traced to the reduction of specific heat at low temperatures. Helium is well below hydrogen because of its higher molecular weight and low heat capacity, while methane is higher than the diatomic gases because of its lower molecular weight and higher heat capacity.

We can see that the methane curve is nearly horizontal. The increase in heat capacity at higher temperatures counterbalances the decrease in den-

For design purposes we must decide on a suitable tube diameter and the allowable pressure drop per foot of tube length. This involves a pre-

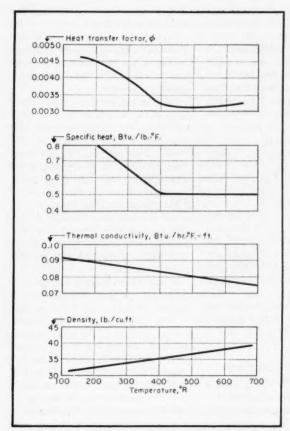


Fig. 3-Properties of liquid paraffins at the boiling point.

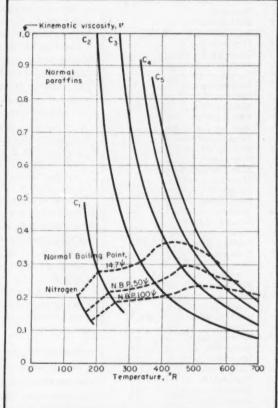


Fig. 4-Kinematic viscosity of normal paraffins.

liminary estimate of the overall length.

Practically, the length is made proportional to the temperature range. The heat transfer coefficient can be a weighted average over the temperature range, or in simple cases it can be evaluated at the mean temperature of the exchanger.

FLOW CAPACITY

With the relation for film coefficient as derived above, we can calculate the flow capacity per tube and therefore the number of tubes required. The mass velocity,

$$G = mM/A = 4mM/n\pi D^2 \quad (10)$$

$$m/n = \pi D^2 G/4M \tag{11}$$

When we solve Eq. (2) for G and substitute in Eq. (11):

$$m/n = \frac{65.2 D^{2.28} M^{0.28} h^{1.28}}{\mu^{0.28} c_p^{1.28}}$$
(12)

and substituting for h its value from Eq. (6),

$$m/n = \frac{3,130 D^{2.668}}{M^{0.446} \mu^{0.111}} \left(\frac{P \Delta P}{LT}\right)^{0.556}$$
 (13)

The temperature and gas terms can be consolidated in a capacity factor, ψ , so that:

$$m/n = \psi d^{2.668} (p \Delta p/L)^{0.668}$$
 (14)

Here m/n is the number of moles per hr. per tube, while the factors on the right have the same dimensions as in Eq. (9). The values of ψ for several common gases are plotted in Fig. 2.

The general order of Fig. 1 is maintained, but the curves are all regular in shape, because specific heat does not enter into the flow capacity. The curves for air or carbon monoxide would be practically identical with the nitrogen curve and therefore are not shown.

CONDENSATION WITH LIQUID FLOW

As derived by Nusselt, in laminar liquid flow with condensate thickness determined by vapor friction, the condensing coefficient is:

$$h = \frac{3}{2} \left(\frac{f_{\rho_f} \lambda k_f^2 G^3}{6 \mu_f L} \frac{1}{\Delta t \rho_g} \right)^{1/3} \tag{15}$$

When the friction factor is replaced by its equivalent in pressure drop:

$$h = 490 \left(\frac{\lambda k_f^2}{\nu_f}\right)^{1/3} \left(\frac{D \Delta p}{L^2 \Delta t}\right)^{1/3}$$
 (16)
$$h = \phi'' \left(\frac{D \Delta p}{L^2 \Delta t}\right)^{1/3}$$

The factor ϕ'' contains only liquid properties. The influence of the vapor phase appears only as the pressure drop; the temperature drop from vapor to condensate is taken to be insignificant.

The resistance computed by this method represents the transfer of heat by conduction through the liquid layer flowing in laminar flow. Experimental coefficients are found to be much higher.

While we would expect the Nusselt relation to hold up to a Reynolds number of about 2,000 in the liquid film, it appears that high vapor velocity breaks up the laminar flow at liquid Reynolds numbers as low as 200. The first effect of vapor velocity is to produce rippling of the liquid

NOMENCLATURE

Surface area, sq. ft. Specific heat, Btu./lb.-*F.

c, Diameter, in. D

Diameter, ft. Coefficient of diffusion D_*

F Friction factor

Friction force, lb. Gravitation constant, ft./hr.º

d G Mass velocity, lb./hr.-sq. ft.

Film coefficient, Btu./hr.-ft.2-°F. h

jh Heat transfer number Mass transfer number

Thermal conductivity,

Btu.-ft./hr.-°F.

K Mass transfer coefficient Mean free path, ft.

L Length of tube, ft. Flow, moles/hr.

M Molecular weight Number of tubes

Nusselt number, hD/k

Pressure, psia. P Pressure, psfa.

0 Heat transfer, Btu./hr. R Gas constant, Btu./mol.

Re Reynolds' number, DG/µ Sm Schmidt number,

Temperature, deg. F. T Absolute temperature, deg. R.

Velocity, ft./hr. u

Fraction vaporized Δ Finite difference

2 Molecular speed Latent heat, Btu./lb. A

Viscosity, lb./hr.-ft. Kinematic viscosity, ft.3/hr.

Density, lb./ft.1

Property factor, heat transfer Property factor, flow resistance

Additional subscripts

Condensing

Fluid, liquid

Gas

Sensible heat

Additional exponent

Number

surface, which will reduce the resistance to heat flow. High vapor velocity may remove liquid from the film by slugging or liquid entrainment. Thus the Nusselt coefficient may apply only to the first few inches of exchanger length below the dew

TRANSITION TO TURBULENT FLOW

Carpenter and Colburn give an expression for the film coefficient at the critical point where the laminar layer builds up to its maximum thickness and then starts to break up into turbulent and laminar layers. The relationship is:

$$h = \frac{k_f (F \rho_f)^{1/2}}{N \mu}$$
 (17)

where F is the frictional force and N is the non-dimensional specification of the critical thickness. The experimental value of N is found to be 11.0.

The friction force is due to vapor friction, liquid weight and the loss of momentum in the condensation from high velocity vapor to low velocity liquid. If we neglect everything but the vapor friction,

$F = \Delta Pg D/4L$

and when we substitute this in the heat transfer coefficient.

$$h = \frac{kg^{1/2}\rho_f^{1/2}(D \Delta P/L)^{1/2}}{2N\mu}$$
 (18)

Taking as an example the condensation of butane at 490 deg. R. dewpoint in an exchanger with d = 0.10 in., and with a pressure drop of 0.5 psi. per ft., we get a critical condensing coefficient of about 8,800 Btu./hr.-sq.

From this it is obvious that laminar liquid layers will not present a significance resistance to heat flow in this kind of a case.

CARPENTER-COLBURN CONDENSATION

Carpenter and Colburn present a semi-empirical relation for condensation which has been correlated with experiments at high vapor velocity.

$$h = 0.065(C_p \rho k/2\mu) f^{1/2} (f/\rho_0)^{1/2} G$$
 (19)

Here the subscript f refers to liquid properties and the subscript g refers to vapor properties. The friction factor, f, is evaluated for vapor flow neglecting the obstruction of the condensate. The mean mass velocity, G, should represent the frictional effect and therefore a root-meansquare value should be used. When we substitute for the friction factor

$$h = 0.065 (c_p \rho kg/4\mu)_f^{1/2} (D \Delta P/L)^{1/2}$$
(20)
$$h = \phi'(d \Delta p/L)^{1/2}$$

The coefficient, ϕ' , involves only properties of the liquid condensate which are dependent on temperature and composition. However, the evaluation of these liquid properties for a mixed condensate requires special consideration.

LIQUID PROPERTIES

The thermal conductivities of most liquids lie in a narrow range. For petroleum fractions, the variation in temperature is shown in Fig. 3.

The specific heat of normal paraffin liquids is about 0.5 for the range C, to C. For ethane it is about 0.6 and for liquid methane about 0.8.

Unfortunately the evaluation of the viscosity of a mixture is quite complex. On Fig. 4, the kinematic viscosity of pure normal paraffin liquids is plotted against temperature.

However, we are dealing with mixtures of hydrocarbons in the condensate. As the temperature falls, the proportion of light hydrocarbons increases. The condensate is, of course, at its boiling point as determined by the pressure. On Fig. 4, we have drawn lines across the viscosity curves at the temperatures corresponding to several constant vapor pressures of the pure components. You will note that the viscosities at these similar boiling points are not very different for the normal paraffins.

A reasonable assumption can be made that mixtures of liquid hydrocarbons will have viscosities along the 1 atm, line as the temperature changes, as long as the total pressure is 1 atm. When a non-condensable gas is present, we assume that the appropriate pressure to use is the partial pressure of the condensable fraction.

While it is true that the total pressure does represent the vapor pressure of the equilibrium liquid, a large part of the total pressure may be due to a small dissolved hydrogen content with very high fugacity. As condensation proceeds at lower temperatures, the effective pressure will decrease. This will increase viscosity.

An important corollary is that the viscosity of a mixed liquid in equilibrium with its vapor is dependent primarily on the pressure and only secondarily on the temperature and composition. The effect of these variables is shown by the curve for the heat transfer function, ϕ' , on Fig. 3. It is computed for an effective pressure of 1 atm.

And with this background material we now have outlined an approximate method of estimating heat transfer rates, which, of course, can be refined if accurate values of physical properties are available.

CONDENSING MIXED WITH NON-CONDENSABLE

When a large proportion of noncondensable gas is present in an exchanger the condensate temperature will not equal the vapor temperature. The major resistance to heat flow is at the interface between the vapor and the liquid. This is practically the same situation as when we cool dry vapor without condensation—the condensate surface and the metal surface performing similarly in the two cases.

The condensing vapor must diffuse through the gas to reach the condensing surface. It does this under the influence of a concentration gradient. The mass transfer of condensing vapor also carries sensible heat to the condensing surface, but this effect is insignificant unless the condensing rate is extremely high.

There is a definite relationship between sensible heat transfer and mass transfer. It has been checked by many experimental results for many widely varied cases. Heat transfer results can be expressed in the form:

$$j_h = (h_\theta/c_p G)(Pr)^{1/2}$$

Mass transfer results can be expressed

$$j_m = (K/G)(Sm)^{1/2}$$

Here K is a mass transfer coefficient in units of lb./hr.-sq. ft.-unit difference in concentration of the condensable at the vapor temperature and the temperature of the condensing surface. Sm is the dimensionless Schmidt number,

$$Sm = \mu/\rho D_{\pi}$$

where D_v is the coefficient of diffusion for the two gases involved.

When experimental values of j_{h} and j_{m} are plotted against Reynolds number for the same geometrical configuration, we find that they coincide; $j_{h} = j_{m}$, from which:

$$K = (h_s/c_p)(P\tau/Sm)^{1/2}$$

The heat transfer by condensation can be expressed by a film coefficient

$$\begin{array}{l} h_c = Q c_p / A \ \Delta t \\ = K \lambda \ \Delta y / \Delta t \\ = (h_s \lambda \ \Delta y / c_p \ \Delta t) (Pr/Sm)^{1/2} \end{array}$$

And the total heat transfer is the sum of the latent heat and sensible heat contributions;

$$h_{t} = h_{s} + h_{c}$$

$$= h_{s} \left[1 + \frac{\lambda \Delta y}{c_{\nu} \Delta t} \left(\frac{Pr}{Sm} \right)^{1/3} \right]$$
 (21)

Now when the flow has cooled through a temperature interval Δt along the length of the exchanger, the sensible heat transferred per lb. of total flow is c, Δt ; the condensation is Δy lb. and the latent heat transfer is $\lambda \Delta y$.

Over a finite length of exchanger the total heat transfer coefficient can be expressed in terms of the ratio of latent heat to sensible heat;

$$h_t = h_s \left[1 + \frac{Q_s}{Q_s} \left(\frac{P_f}{Sm} \right)^{1/3} \right] \quad (22)$$

If the Schmidt number and Prandtl number are equal, as they are for airwater vapor mixtures, then the same surface which transfers the sensible heat with the dry gas film coefficient will also transfer the latent heat.

Water vapor in air represents a light vapor in a heavy gas. For mixtures of hydrocarbons in hydrogen, we are dealing with a heavy vapor in a light gas. Here we can expect a radically different case.

EVALUATION OF SCHMIDT NUMBER

The most difficult part of our design calculation for total heat transfer, then, is the evaluation of the Schmidt number. The kinetic theory of gases leads to an expression for the diffusion coefficient between two gases:

$$D_v = \pi/8(n_2\Omega_1l_1 + n_1\Omega_2l_2)$$

where,

n is the mole fraction Ω is the arithmetic mean molecular speed

 $\begin{array}{c} \text{speed} \\ l \text{ is the mean free path} \end{array}$

Similarly the coefficient of viscosity of each gas is

$$\mu = 0.30967 \rho \Omega l$$

or the kinematic viscosity,

$$\nu = \mu/\rho = 0.30967\Omega l$$

When we substitute v in the expression for the diffusion coefficient;

$$D_* = \frac{\pi}{(8)(0.30967)} (n_2\nu_1 + n_1\nu_3)$$

and the Schmidt number:

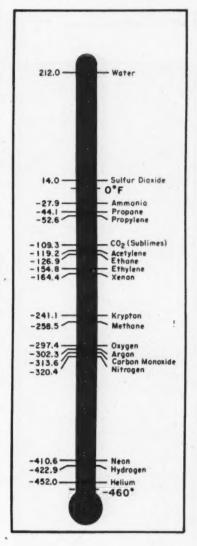
$$Sm = \nu/D_{\nu} = 0.789 \left(\frac{n_1\nu_1 + n_2\nu_2}{n_2\nu_1 + n_1\nu_2} \right)$$
 (23)

Since the kinematic viscosity is sensitive to pressure, we would prefer to use absolute viscosity. It appears reasonable from the kinetic viewpoint (and is confirmed by experimental determinations of diffusion coefficients) that the kinematic viscosity in a mixture is not determined by partial pressure or density but rather by the total pressure or total density of the molecules.

$$\nu \propto \mu/M$$

The Schmidt number can then be expressed in terms of component viscosities:

$$Sm = 0.789 \frac{n_1 M_2 \mu_1 + n_2 M_1 \mu_2}{n_2 M_2 \mu_1 + n_1 M_1 \mu_2}$$
 (24)



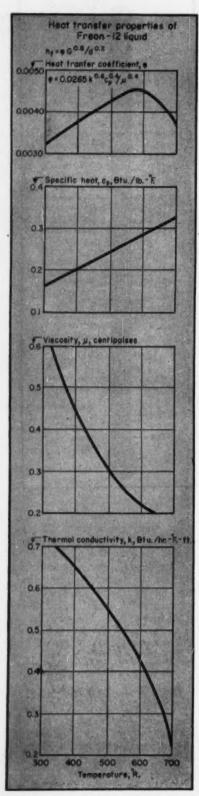
For water vapor in air this checks out to Sm = 0.71, which is practically equal to the Prandtl number for air.

For hydrogen-hydrocarbon mixtures, the Schmidt number has been calculated for 10 percent hydrocarbon in hydrogen at the normal boiling point of the hydrocarbon. The values are:

Hydrocarbon	Sm	$(Pr/Sm)^{1/2}$
Pentane	6.03	0.350
Butane	5.45	0.368
Propane	5.23	0.376

This is a very much less favorable situation than water-air. The surface or temperature difference required for condensation will be substantially greater than that required for dry gas cooling.

Taking the factor at 0.37, in a case



where the latent heat and sensible heat loads are equal, the total coefficient is 37 percent greater than the dry gas coefficient, while the load is doubled.

Therefore the condensing exchanger will require 46 percent more surface or temperature difference than the corresponding dry exchanger.

EVAPORATION HEAT TRANSFER

After condensables have been liquefied and separated, they may be vaporized in return passes of the exchanger, preferably against the condensation of the same liquid. The necessary temperature difference is provided by reducing the pressure of the evaporation below the partial pressure of the same constituent in the condensing pass.

The film coefficient in the cold end of the pass will be that corresponding to solid liquid flow. As vapor is formed, the volume is increased. Therefore the linear velocity is increased.

However, the density of the liquid in contact with the metal wall is substantially unchanged. The film coefficient increases with vaporization as long as the vapor is in the inner phase, in the form of bubbles.

When the vaporization proceeds to a point where the phases invert, with liquid drops entrained in the vapor, then the film coefficient drops off to the dry gas value. The volume can be expressed in terms of the vaporized fraction Y:

$$u = (G/\rho_f)[Y(\rho_f/\rho_g + 1) - 1]$$

If we take 250 as a representative value of the ratio of liquid density to vapor density for hydrocarbons, and if we neglect the minor terms, we then get:

$$h = 83h_{f}Y^{0.8}$$

This indicates that the heat transfer goes up very fast with vaporization, at least in the early stages. Now let's assume that the coefficient falls off quadratically from this fast-rising line, according to the expression:

$$h = h_f(83Y^{4.8} - aY^3) \tag{25}$$

and that it reaches the gas film coefficient at Y = 1.0

This evaluates the constant;

$$a = 83 - (h_g/h_f)$$

The mean coefficient for the complete evaporation process can be obtained by integration.

$$h_m = \int_0^1 h \, dY$$

$$= h_f \left[\frac{83 \, Y^{1.3}}{1.8} - \frac{a \, Y^3}{3} \right]_0^1$$

$$h_m = 18.4 h_f + 0.33 h_g \qquad (2)$$

where h, is the liquid coefficient at the entrance to the evaporator and h, is the vapor coefficient at the dew point.

DESIGN OF EVAPORATORS

The design procedure can be as follows. For hydrocarbon evaporation, we generally want to superheat the vapor up to ambient temperature. The exchanger pass is designed for the superheating section by the methods previously discussed, to get a reasonable pressure drop for the vapor.

This results in a value of h, at the dew point. Using the same mass velocity and the properties of the saturated liquid, we calculate the liquid film coefficient. We get the mean evaporation coefficient from Eq. (26). Dividing this into the latent heat load, we get the product of surface and temperature difference required in the evaporating section.

The liquid film coefficient can be calculated by a reduction of the general heat transfer relation to:

$$h_f = \frac{0.023k^{0.6}c^{0.4}G^{0.8}}{\mu^{0.4}D^{0.2}}$$

$$h_f = \phi'G^{0.8}/d^{0.2}$$
(27)

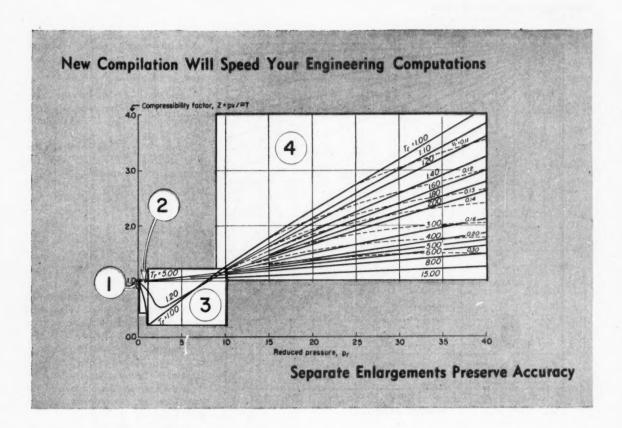
where G is the mass velocity in lb./hr.sq. ft., d is the hydraulic diameter in inches, and the factor of contains the liquid property terms which are dependent on temperature.

These have been evaluated for boiling hydrocarbons on Fig. 3 and for Freon-12 on Fig. 5. This general picture of evaporation has been demonstrated at least qualitatively by Yoder and Dodge.

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2. The Institution of Mechanical Engineers, London, The American Society of Mechanical Engineers, Proceedings of the General Discussion on Heat Transfer, 11-13 September 1951," A. P. Colburn, p. 1; R. J. Yoder and B. F. Dodge, p. 15; E. F. Carpenter and A. P. Colburn, p. 20; J. C. Smith and H. T. Robson, p. 38; H. Verschoor and S. Stemerding, p. 201.



HOW TO USE THE NEW . . .

Generalized Compressibility Charts

L. C. NELSON and E. F. OBERT

Note—At the 1953 annual meeting of ASME, Professor Edward F. Obert of the Mechanical Engineering Dept., Northwestern Technological Institute, Evanston, Ill., announced the completion of a new set of generalized compressibility charts. Older charts were developed some years ago but their validity has not been too well established. Even today high pressure data are extremely meager.

With the assistance of L. C. Nelson, Royal Cabell Fellow at the Institute, Prof. Obert now contributes these newly developed charts for publication.

The editors of CHEMICAL ENGINEERING are proud to reproduce these charts for the benefit of the chemical process industries and the chemical engineering profession—ED.

2, 3, 4 and 5, have been developed from the averaged experimental data of 30 gases. These gases and their critical constants are listed in the table on the next page.

The coordinates of the charts are the compressibility factor, Z and the reduced properties that are directly related to the critical constants:

$$Z = pe/RT$$

$$p_{r} = p/p_{e}$$

$$T = T/T$$

and the pseudo reduced volume,

 $v_r' = v/(RT_o/p_o)$

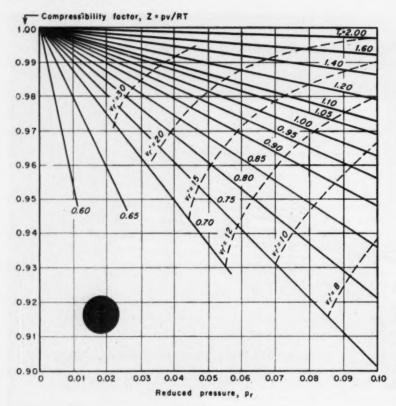
where the subscript, c, refers to the critical value.

Figs. 1 and 2 represent the averaged data of 26 of the gases listed in the table, but excluding hydrogen, helium, ammonia and water. With

the exception of these gases, the maximum deviation of the chart from the experimental data was of the order of 1 percent. The gases H_{\circ} and $H_{\circ}O$ exhibited maximum deviations slightly greater than 1.5 percent, while He and NH $_{\circ}$ could not be correlated satisfactorily on these charts below $T_{\circ} = 2.5$.

Fig. 3 was constructed from the averaged data of 26 of the gases shown in the table, excluding hydrogen, helium, ammonia, and methyl fluoride. However, the data for all these gases were not available throughout the complete range of the charts. For gases tested, the maximum deviation was of the order of 2.5 percent, except near the critical region.

Fig. 4, in the range from $p_r = 10$ to $p_r = 40$, was derived from the



Critical Constants of Gases (Absolute Zero at -273.16°C.)

T, °K. p, atm. Substance 37.17 111.3 47.996 48.7 n-Butane......425.17 37.47 Isobutane 408.14 36.00 39.7 Carbon dioxide..... 304.20 72.85Carbon monoxide 132.91 34.529 n-Deuterium...... 38.40 16.40 48.20 35.6 50.50 Helium..... 5.19 2.26 n-Heptane......540.17 27.0029.94 12.797 88.8 Methane......191.05 45.79 Methyl fluoride......317.71 58.0 Neon..... 44.39 26.8633.54 Nitrie oxide180.3 64.6 50.14 33.10 n-Pentane......471.0 32.9242.1 45.61 218.167 57.89

data of the following gases: oxygen, argon, air, nitrogen, carbon monoxide, ethane, methane, ethylene and propane. The maximum deviation for these gases from the averaged value of the compressibility factor, Z, was not greater than 5 percent.

Above $T_r = 2.5$, hydrogen and helium were found to agree within the accuracies stated for the various charts if the so-called Newton corrections were made to the critical constants $(T_c + 8, p_c + 8)$. Below $T_r = 2.5$ the charts will not predict the data for these gases. In the regions above $T_r = 5$, hydrogen and helium data, corrected by the Newton constants, were used for the construction of the isotherms.

Fig. 5 is a unique presentation of Fig. 3 offering the advantage that interpolation for an intermediate value of v.' is eliminated.

It is understandable that validity of older generalized compressibility charts has not been too well established when we consider that the charts were developed some years ago, and even today, high-pressure data are extremely meager. The underlying data for the charts presented in this

article are taken from the most complete bibliography survey made up until 1952.

How to Use Them

Example 1—Determine the compressibility factor for neon at a temperature of -75 deg. C. and a volume of 200 cc./mole.

Solution—We shall solve first for the reduced temperature and the pseudo reduced volume.

$$T_r = T/T_c$$

= 198.2/44.4
 $T_r = 4.46$

and,

$$v_{\tau'} = v p_c / R T_c$$

$$= \frac{(200)(26.9)}{(82.06)(44.4)}$$

$$v_{\tau'} = 1.48$$

Since v_r' is known we can use Fig. 5 to obtain our answer. This chart plots a pressure-volume factor, $p_r v_{r'} = ZT_{r_r}$ against p_r .

Along the top ordinate (where p_r $v_r' = 5.0$), the value of $v_r' = 5/p_r$. Construct a line of constant $v_r' = 1.48$. This will connect the origin with the point on the top ordinate opposite $p_r = 3.39$.

At the intersection of $T_r = 4.46$ with this line, $p_r = 3.2$. Therefore,

$$ZT_r = 4.67$$

or,

$$Z = 1.05$$

Example 2—Determine the compressibility factor for ethylene at 100 deg. C. and 150 atm. pressure.

Solution—We solve for the reduced temperature and the reduced pressure as follows:

$$T_r = T/T_c$$

= 373.2/283.1
 $T_r = 1.32$

and

$$p_r = p/p_e$$

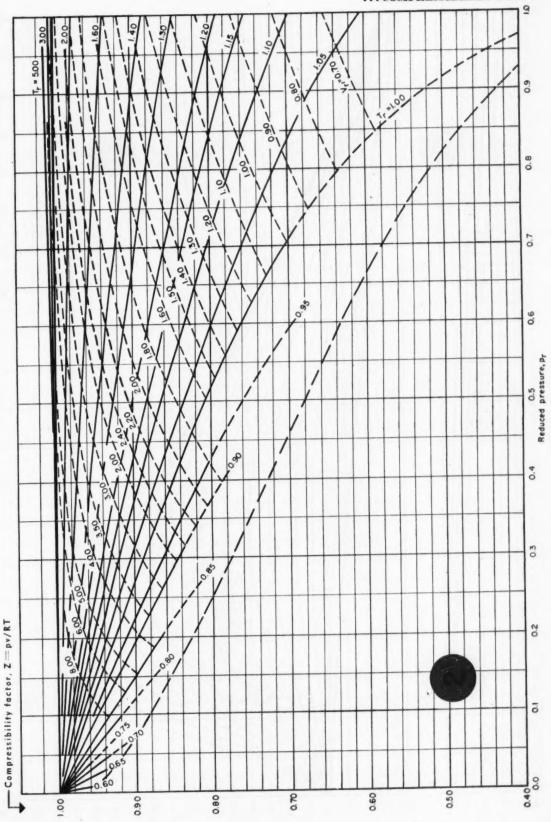
= 150/50.5
 $p_r = 2.97$

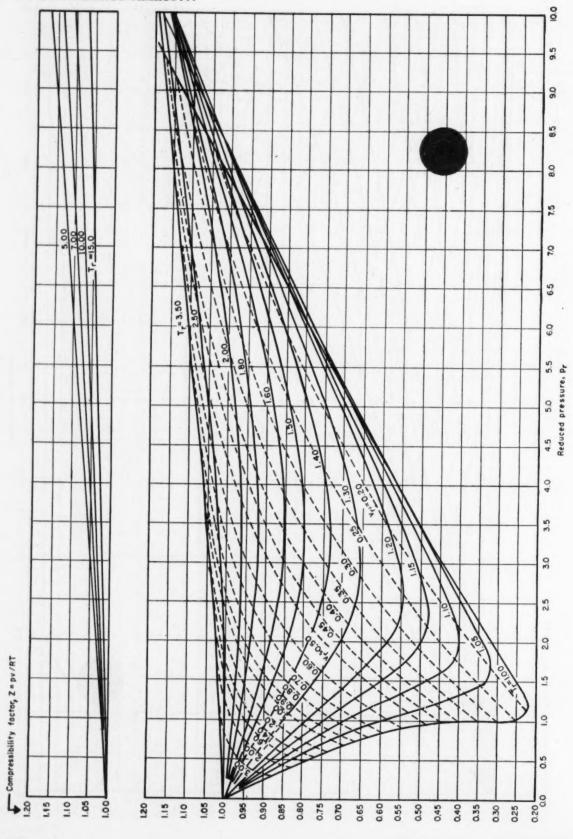
Select Fig. 3 to obtain:

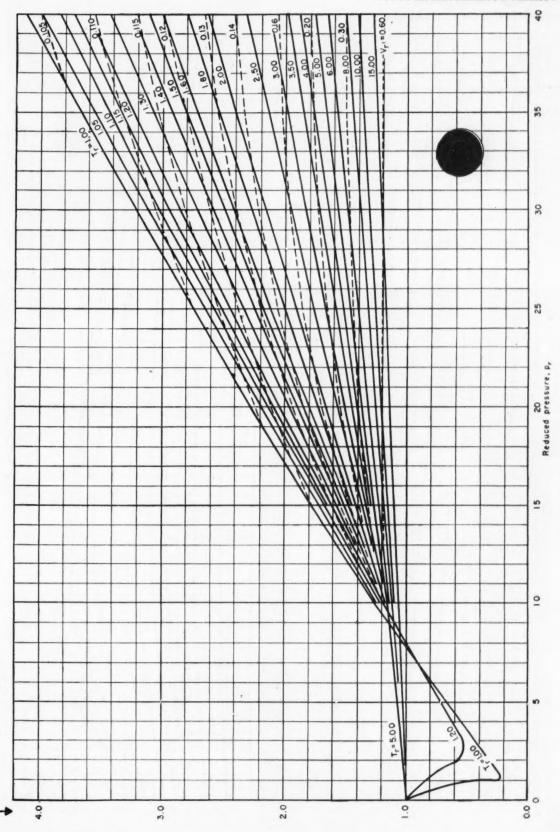
$$Z = 0.673$$

Nomenclature

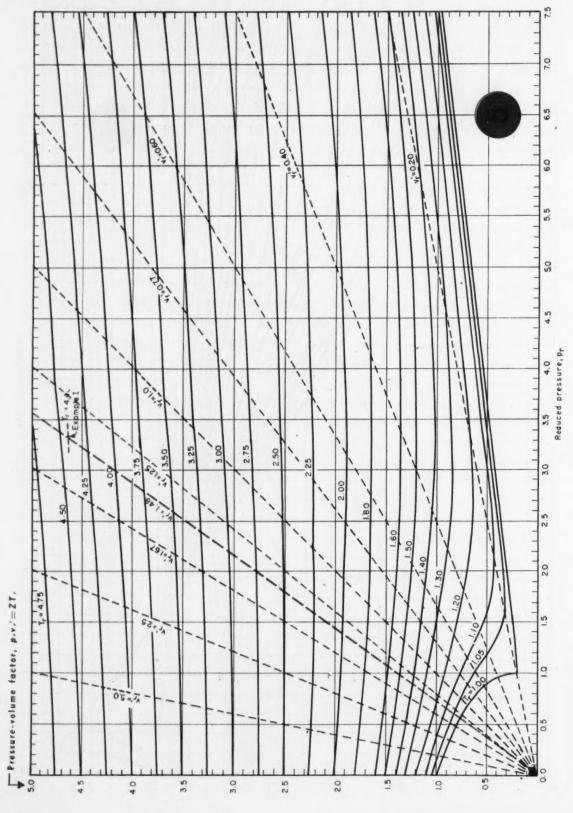
- p Absolute pressure
- p. Critical pressure
- p, Reduced pressure
 R Universal gas constant
- T Absolute temperature
- Te Critical temperature
- T, Reduced temperature
- v Volume
- v,' Pseudo reduced volume Z Compressibility factor





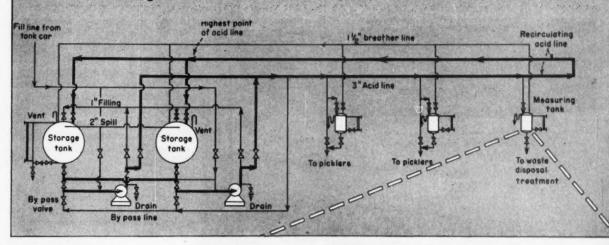


Compressibility, factor, Z = pv/RT



from Storage Area ...

... To Production Area



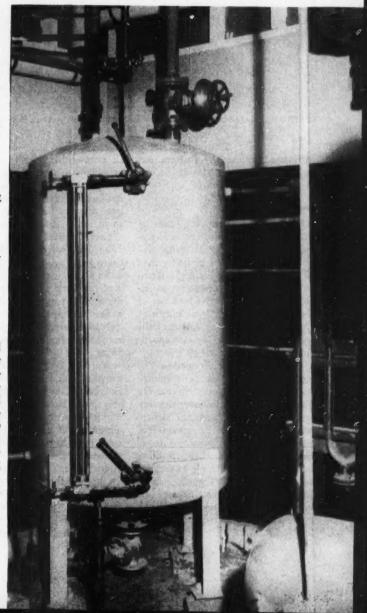
New Ideas for Handling Sulfuric

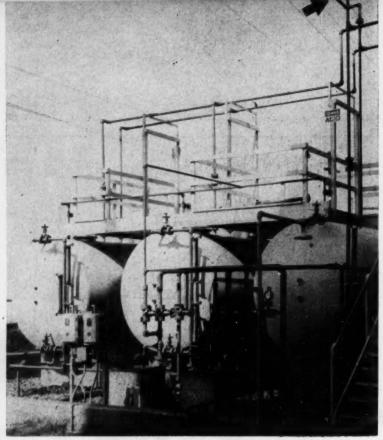
- Pitched pipeline drains when not in use—increases safety.
- Breather line helps keep system dry —decreases corrosion.

F. J. HENDEL and H. B. PATEMAN

sers of a chemical oldtimer like sulfuric acid still face problems in managing the corrosive stuff. Take the Rheem Manufacturing Co. for instance. Its steel and brass pickling plant in Burlington, N. J., requires 50-100 tons of concentrated acid weekly to supply pickling machines and adjust alkaline wastes. The problem was initially this: how to move the acid safely with minimum corrosion and cost through a half-mile-long recirculation pipe connecting storage vessels with pickling and measuring tanks.

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JUMP-OVER between acid and breather lines smooths out pressure in system.

An extensive distribution setup with some noteworthy features was installed by the Wigton-Abbott Corp. to meet Rheem's need.

Breather System

Economy dictated the use of straight carbon steel for tank and piping construction, satisfactory for contact with sulfuric acid of better than 60 deg. Be. Keeping the acid concentration above that minimum is important, then, and here's how one of the design features, the "breather" system, helps prevent dilution of the very hygroscopic acid by atmospheric moisture.

A 1½-in. pipeline, located a few feet above the acid distribiution line and parallelling its course around the plant, is interconnected with the storage tanks, measuring tanks and recirculation line. Thus is a common vent afforded to all equipment; internal air which is displaced when filling storage vessels or pumping to pickling areas can move, or breathe, freely throughout the system. Because the only vent to the atmosphere for the entire system is through single outlets (open, down-curved, 2-in. pipes)

on each storage tank, intrusion of wet air from within, due to emptying of vessels and to air temperature changes, is limited. And, since sulfuric acid, itself a good desiccant, traps any moisture entering the storage tanks, the air in the system remains dry.

Overflow lines leading from measuring tanks to the pickling machines below are provided with seals—goosenecks filled with sulfuric acid—to prevent moist air entry. Measuring vessels are filled initially to the very top so that acid will overflow through the seal and restore any sulfuric which may have been blown out during rapid filling.

So, even under the most adverse conditions, dilution of acid via moist air action in the storage area will occur only slowly. However, during a lengthy shutdown period when there is no movement of acid from the storage area, tank corrosion could occur at the surface level of the acid where a diluted layer has gradually formed. To preclude this happening, the operators mix the acid in the storage vessels from time to time by pump recirculation.

Carbon steel was judged inadequate,

on the other hand, for valves and pumps because their construction makes them more vulnerable to corrosion—acid leaking around pump shafts and valve stems may be diluted by rain or moisture from the air. A special austenitic stainless steel containing high percentages of nickel (24-30) and chromium (19-21) and low carbon content (0.07 percent) was selected.

Safety Measures

Pumping of acid for refilling measuring tanks and pickling machines is limited to weekends when the metal plant is down. Valves in the return line to the storage vessels are kept open so that the fluid recirculates freely with no unnecessary pressure buildup.

The recirculation line is pitched so that after pumping is finished any acid remaining in the piping drains back to the storage area by gravity (see the highest point in the line as indicated on the flow sheet).

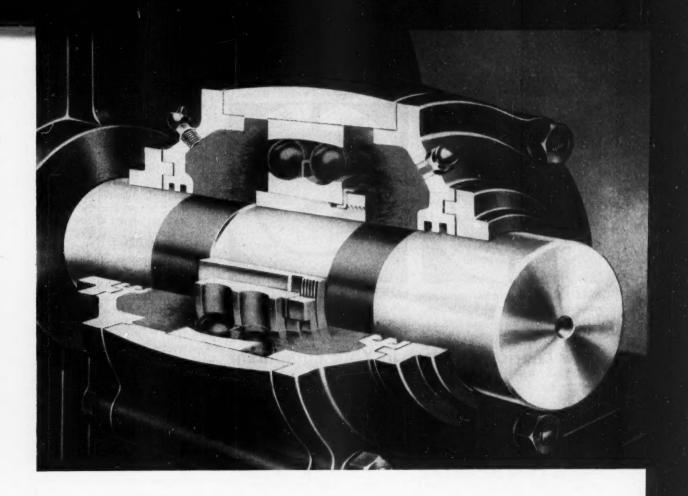
This pumping schedule and piping arrangement keeps the overhead acid line in the production area empty when hundreds of operators are working in the metal plant.

Should the production area require acid on weekdays provision was made to accelerate draining of the distribution line after delivery. A bypass valve and line (see flowsheet) permit the pumps to reverse flow in the line and so empty its contents quickly.

Pumping Features

The pumps located beneath the storage tanks and used for moving sulfuric acid to production areas also serve to unload acid from tank cars. Enough acid for priming is available from suction lines and storage tanks to enable the pumps to pull from the tank car; compressed air discharge with its possible hazard is necessary only when storage vessels are empty.

Total dynamic head of the pumps is much less in the unloading operation than when propelling sulfuric acid to pickling and measuring tanks. To avoid pumping against this greatly reduced head—motor injury at higher horsepower requirements—the discharge piping leading to the storage tanks was made of reduced diameter (1 in.).



Lubrication

Written for plant engineers, this report will help you solve the many unique problems encountered in the lubrication of chemical equipment.

R. W. CLARK, J. H. FULLER and J. A. GLEBER

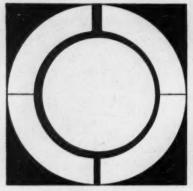
The chemical industry today is intensively competitive in its striving to supply products at the lowest dollar cost. All factors that contribute to this must be fully exploited and lubrication is certainly one of the most important of these.

BILL CLARK, JIM FULLER and JAKE GLEBER are all in the Engineering Service Division of the Engineering Department, E. I. duPont de Nemours & Co., Newark, Del. Their special duties are to advise on plant lubrication problems and needs throughout the Du Pont organization.

An intelligent, well-planned lubrication program will save you money in at least three areas: lubricant costs, application costs and general maintenance costs. The continuing inspection provided will ferret out incipient failures, thus minimizing unexpected major shut-downs.

But chemical plants employ a great multitude of equipment types and designs. To simplify this situation, the authors have broken these down into their basic machine components —bearings, gears, drive chains and sliding surfaces. Thus you can take the information discussed and apply it immediately to just about any piece of machinery in your plant, regardless of its complexity or size.

To further help you recognize and solve the unique chemical and mechanical problems involved in chemical equipment lubrication, there's a brief but practical section on the ways lubricants function to cut down friction. This is supplemented by a more detailed discussion of just what lubricants are available to industry today, what's being done to make them more effective and how you can choose the best ones for your particular lubrication needs.



FULL FLUID FILM of lubricant means minimum contact between bearing surfaces.



BOUNDARY LUBRICATION often results from improper design sacrifices.

How Lubricants Work in Your Equipment

Knowing the ways a lubricant functions will aid you in setting up a more economical lubrication program.

Lubricants have one basic purpose, to reduce friction by keeping moving surfaces separated. Without friction reduction, it would be impossible to obtain motion between two objects. And in accomplishing their objective, lubricants also reduce wear and damage to the rubbing surfaces and minimize power loss and heat generation.

Degree of surface separation is approximately inversely proportional to the amount of friction, except in those cases where unusually thick oil films develop between the surfaces. Also, the amount of separation obtained between the two moving surfaces defines the type of lubrication. There are three recognized types:

 Hydrodynamic or full-fluid film lubrication—Complete separation of the surfaces by the lubricant; no contact between the surfaces except on starting or stopping.

 Boundary lubrication—Oil film is incomplete; surfaces are apt to come in contact.

 Dry lubrication—No film present to separate the surfaces; contact between them is very intimate.

Full-Fluid Film

In hydrodynamic lubrication a pressurized film of oil forms when there is relative movement between two surfaces, such as in a journal bearing (above). Fluid, due to its viscosity and adherence to the bearing surfaces, is forced into the clearance space and tends to build up positive pressure. This pressure then separates the surfaces, which ride on the lubricant film.

The thickness of the oil wedge formed in a bearing is a function of viscosity, speed and load. Film thickness and pressure developed on the loaded side can be so great that excessive wear results on the unloaded side if there is no pressure relief. Full-fluid film lubrication can, of course, be formed between sliding surfaces, too.

In a well-designed full-fluid film lubricated bearing, the coefficient of friction is of the order of 0.001 to 0.01. Such bearings are practically indestructible—large steam turbine bearings, for example, run for years.

More consideration should be given to the use of this type of lubrication in our present-day machines. Admittedly, a well-designed bearing for hydrodynamic film lubrication can be expensive. But the life factor, compared to that of other types of bearings, is extremely high and nearly always justifies the extra cost.

Boundary Lubrication

This is closely related to full-fluid film lubrication. Usually it is the result of design sacrifices or improper basic design, where a full-fluid film cannot be developed to keep the bearing surfaces completely separated.

Three main factors cause boundary lubrication: oil viscosity is too low, load is too heavy or the speed is too slow. It all adds up to lack of film thickness and pressure sufficient to support the bearing load. As a result, metal-to-metal contact of the bearing surfaces occurs.

Complete correction of these conditions is not possible unless a change in design is made. But by using proper lubricant additives, such as oiliness and extreme pressure agents, wear and friction can be reduced to accepted limits under boundary conditions (see page 216).

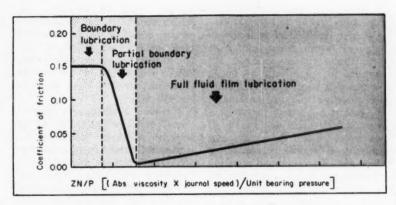
Remember, however, that boundary lubrication should be avoided whenever possible since it cannot be completely eliminated by the use of additives, only alleviated. It is best to attempt, through proper design, to have full-fluid film lubrication in all bearings.

Briton Opens Way to Hydrodynamic Theory

The behavior of oil in a journal bearing was first noted by Beauchamp Tower of England in experiments on railroad journals. Attempting to determine the method of reducing the very rapid wear rate of bearings in service, he used a journal with a loaded bearing placed in the upper half, such as are still in use today. The bottom portion of the journal ran in an oil bath.

He first attempted to introduce extra oil in the top half of the bearing by drilling a hole in the upper shell. When the journal came up to speed, however, the oil came up through this drilled hole. As Tower attempted to stem the flow with a cork, he found that the cork was blown from the hole as the journal speed increased, indicating that a positive pressure of oil was building up between the journal and the bearing.

This pointed the way toward recognition of full-fluid film lubrication and opened the door to Reynolds' classic mathematical analysis of the performance of oil in a bearing. The hydrodynamic theory resulted.



Dry Film Lubrication

Here there is no fluid or unctuous type of material available to assist in separating the rubbing surfaces. Dry lubrication is found where no lubricant can be tolerated or where a lubricant would not stay on the surfaces if it were present, such as in some dryers, kilns and other specialized chemical equipment.

Very little can be done to hold down the rapid wear rate and exceedingly high friction encountered in dry lubrication. But in general, always use dissimilar materials or materials of different hardness. It's better to have one metal or material actually shear at the surface under dry lubricating conditions, rather than have both of them shear, such as would be the case if they were the same material or hardness.

Much work has been done recently on this problem and many techniques are being evolved for conditions where it is necessary to operate without lubricants. These include the use of unique bearing materials, as well as dry lubricants that can withstand higher temperatures than fluid or grease type materials (see page 219). Such products are a great help in reducing and preventing material damage when you have to use dry lubrication.

Which Type Do You Have?

The role of friction in lubrication and its relationship to the other factors involved can be summarized by a diagram similar to that used in the study of fluid flow. When the problem of friction in a bearing is attacked by dimensional analysis we find that the coefficient of friction is a function of a dimensionless parameter, ZN/P—where Z represents viscosity, N is speed and P is unit load.

This relationship (left) determines the type of lubrication encountered. When ZN/P values are greater than at point B, a full-fluid film develops. In the region between A and B, partial boundary lubrication exists. Lower than A, you have boundary conditions approaching dry film lubrication. The diagram will be discussed later as a useful tool for combating friction in operating mechanisms (see page 220).

Many Lubricants Are Available to the Chemical Industry

To pick the best you'll need a working knowledge of them all: oils, greases, solids and synthetics.

Before getting into the lubrication requirements of the chemical industry, let's take a look at the many compounds available to industry and at what makes them good—or not so good—for various applications.

The vast majority of lubricants, of course, come from crude petroleum, made by natural conversion from sea, animal and vegetable deposits. And since the raw materials were not the same in each location, it's not surprising that crude oils from different wells are quite different and that lubricating oils made from these crudes have different properties.

Before it's refined, crude oil is generally a dark brown syrupy liquid, a complicated mixture of compounds. It actually contains materials ranging from light gas to heavy asphalt. The

first step in refining, therefore, consists of separating each product by distillation.

Lubricating oils and greases are manufactured from the fraction that boils higher than gasoline and gas oils, but lower than residual fuels. As they come from the fractionating tower, these stocks contain waxes, asphalts and other undesirable material and need additional refining. Treatment given each oil depends on the source of the crude oil and on the intended service of the finished lubricants.

Three methods are used to purify oils: treating with acids, with solvents and with clay. Although each of these processes uses different chemicals, all purify by removing materials of poor quality.

Lubricating oils can be further im-

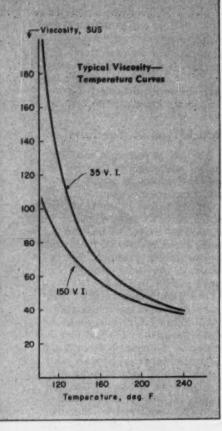
proved by adding chemicals to, rather than removing materials from, the oil. Such chemicals are called additives and are normally employed on the basis of one or more of the following considerations:

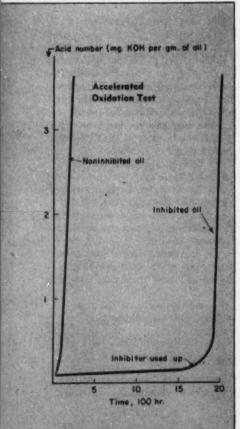
- To impart properties not inherent to petroleum oil.
- To extend or accentuate characteristics of the lubricating oil.
- To replace useful components of lubricating oil fractions removed in refining processes.
- To obtain desired properties more economically than could normally be achieved by existing refining processes.

For details on the various types of additives available and how they work, see page 216.

Lubricating Oils

In discussing lubricating oils from the practical standpoint, two factors





are of extreme importance: viscosity and quality.

Viscosity is the internal fricton of the liquid which causes it to resist instantaneous change of shape. It's measured in this country by timing the period it takes to empty a measured quantity of oil through a standard size hole at a specific temperature—generally 100 or 210 deg. F. All oils will have different values at these temperatures because petroleum oils "thin out" as temperature is raised. At higher temperatures, therefore, the oil will flow out of the standard container much more rapidly, giving a lower viscosity in seconds.

The actual units of viscosity in general use in industrial lubrication are Saybolt Universal Seconds (SUS). Knowing the specific gravity, you can convert these units to absolute viscosity—which may be required in calculation of bearing performance.

High VI Is Important

The term viscosity index, generally called VI, is used by lubrication engineers as a measure of relative change of viscosity with temperature for any given oil. Viscosity of oil from some crudes will change rapidly with temperature, whereas that of oils from other crudes will change more slowly.

Some years ago an empirical scale was set up to grade the then best and poorest oils in regard to this change. The one having the largest change was given a viscosity index of 0 and the one with the least change was given a viscosity index of 100.

Since paraffin base oils usually change the least, higher index oils are generally said to be of this type. Similarly, asphaltic base or naphthenic oils have the greatest change of viscosity with temperature and the low VI oils are generally classed as such. The change in viscosity with temperature and the difference in rate of change of two oils with different VI are shown in the chart at left.

What Makes Quality?

The term "quality of lubricating oils" does not refer to any one property. In different applications it's judged in different ways. For example, a bearing operated over an extremely wide temperature range needs a lubricant with a high viscosity index. A

lubricant used for extremely long periods of time at high temperatures requires resistance to formation of gums, varnishes and sludges. A lubricant subject to severe water contamination in a circulating oil system must allow water to separate out readily or rust will ensue.

Therefore, in talking about quality, several individual properties of oil must be considered—each more important in certain applications than others. Let's begin by looking at what happens to an oil when it's exposed to a fairly high temperature for a long period of time. This condition is frequently met in the chemical industry in steam turbines, dryer roll bearings and internal combustion engines, to name only a few.

When oil is in contact with air at high temperatures, it oxidizes. The chemicals formed are acidic in nature and react with more oxygen to form varnish, gum and sludge. When this happens the oil becomes corrosive to a certain extent and may react with the bearing metals. Also, viscosity of the oil increases and deposits are formed on all parts of the lubricating system.

The rate at which an oil oxidizes depends on two factors. The most important is the operating temperature, since the higher the temperature the more rapid the oxidation. As a rule of thumb, the rate of oxidation doubles with every 18 deg. F. temperature increase. This change in oxidation rate brings out the importance of frequent oil changes in hotrunning equipment.

The other major factor influencing the life of a lubricant is the metal or metals present in the lubricating system, Copper, copper alloys and lead are the worst actors in this respect, since they serve as catalysts for the oxidizing process.

Stop Rusting

Another feature of lubricating oils that's part of quality is the ability to prevent rusting when water finds its way into the oil. Tests show that the degree of protection provided by different mineral oils is not the same and, generally speaking, the more highly refined the oil the less protection it gives. This is probably because some of the natural rust preventives are

removed from the oil in refining operations.

To meet this contingency, refiners generally improve rust preventive properties in highly refined oils by adding chemicals called rust inhibitors. It is good practice to use rust inhibited oil whenever it is possible for water to get into the lubrication system.

Other quality features of lubricants are pour point, flash point and color. The pour point is the lowest temperature at which an oil will flow. It is important for equipment operating at very low temperatures, especially if the lubricant is supplied in either drip feed, wick feed or bottle oilers. Flash point is not a critical feature since operating temperatures seldom approach that temperature in the chemical industry.

Color is important in the case of certain light petroleum fractions, particularly products used in dry cleaning or textile equipment. Its chief significance, as applied to the darker oils, is that it is a generally accepted index of uniformity of a given grade or brand. However, in these oils, color cannot in any way be related to performance characteristics of the oil as a lubricant.

Wetting Oils

Proper lubrication of steam cylinders requires careful choice of lubricant and close attention to its application. This is because temperatures are high, speeds are often low, motion is reversing and moisture is usually present.

High temperature reduces oil viscosity and moisture tends to displace the lubricating film from the cylinder walls. To combat these conditions, a high viscosity oil compounded with a small percentage of vegetable or animal oils must be used. Compounding makes the oil "wet" and adhere to the walls and thus resist the washing effect of wet steam.

Where superheated steam is used and moisture is not a problem, a high viscosity non-compounded oil, such as a solvent refined bright stock,, is normally recommended. The fact that fatty oils deteriorate more rapidly at high temperatures and do not separate readily from condensate adds to the desirability of the straight mineral oil in many process applications.

Lubricating Greases

Grease is a semi-solid material, combining a fluid lubricant with a thickening agent, usually a soap. In making grease, the soap ingredients are mixed and heated in large kettles and oil is added with agitation. The mixture is then cooled at a controlled rate. There are many kinds of greases, some using petroleum oils, others synthetics. The general types used for average lubrication requirements fall into four groups:

• Water resistant—having calcium or aluminum soap bases; for operating temperatures from below 0 to 180 deg. F.

 Water soluble—soda base; for applications above freezing to roughly 400 deg. F.

 Multipurpose—water resistant types for both high and low temperature applications.

 Synthetic — using synthetic fluids in place of natural mineral oils.

Calcium: Normal Temperatures

Most calcium soap base is produced by saponification of a grease base, composed of whole fat, such as tallow or fatty acids, with lime and water. After the soap is made, lubricating oil is added slowly with the required amount of water to form the necessary emulsion of soap and oil. The total amount of mineral oil added determines the body or consistency of the finished grease.

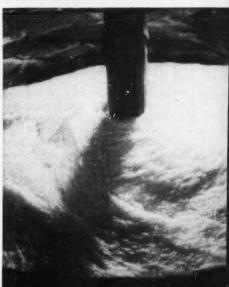
Assuming that only quality fats of the proper type and well-refined lubricating oils are used, the selection of a calcium base grease is governed by a few fundamentals, namely, temperature at which the grease is to operate, type of bearing, speed of the bearing, clearance, pressure and the frequency of relubrication.

For normal requirements the viscosity of oil in a lubricating grease should be about the same as if straight oil were used. It must be kept in mind that the lubricating grease is really a jellied oil and it is actually the oil that does most of the lubricating.

The most important factor to remember when selecting a calcium soap grease is that they are generally not safe to use for extended periods of time where the operating temperature may cause rapid loss of water content. The reason is simple. Calcium soap greases







Additives Make Lubricants—Here's What They Can Do

▶ Oiliness Agents—These are beneficial in lowering over-all power requirements. Their improved film strength permits use of lower viscosity oils with no reduction of load carrying capacity.

Early experiments on the capillary properties of various oils showed that superior lubricating properties of saponifiable oils were due to the presence of small quantities of free fatty acids which were adsorbed on metallic surfaces. Soon after World War I a major oil company started marketing a motor oil containing oleic acid.

But in the early 1930's, certain synthetic esters were shown to be as effective as free fatty acids in reducing the coefficient of friction of mineral oils and were more stable to oxidation. Several additives of this type are used today.

▶ Extreme Pressure Additives—These materials are used on heavy duty equipment where power transmitted through gear drives and bearings results in high unit loads. Under such severe operating conditions straight mineral oils do not provide adequate film strength and the high squeezing pressure may rupture the film, causing metal-to-metal contact and scored surfaces.

Lead, sulfur, chlorine and phosphorus provide EP properties. Lead is usually added as an oil soluble soap. The others are introduced in the form of a number of chemical compounds that are soluble in lubricating oils.

Many test machines are used to measure the load carrying capacity of EP lubricants. Some of the more familiar ones are: Timken, Falex, Almen and SAE machines.

▶ Pour Point Depressants—Poor flow characteristics of lube oils at low temperatures are usually caused by high wax content. Prior to 1930 the manufacture of oils suitable for zero weather presented a very serious refining problem. Naphthenic oils with inherently low pour points were undesirable because of unfavorable viscosity-temperature characteristics. Dewaxing of higher quality lube oils involved exorbitant refrigeration costs and often removed valuable lubricating components.

The action of pour point depressants is unique. They do not prevent wax crystallization at low temperatures, but rather are apparently absorbed on the surfaces of small wax crystals as they form, preventing their growth and their being filled with oil. This prevents the formation of solid gel structures made up of a network of oil-filled wax crystals.

Use of pour depressants in industrial oils permits outdoor equipment to be run with just one oil all year long. High viscosity index oils having low pour point are desirable for such applications as gear cases, ring-oiled bearings and circulating systems.

► Viscosity Index Improvers—All oils change in viscosity with temperature variations. The rate of change is defined by their viscosity index. By selecting the proper crude source and refining methods (see text), it's possible to make lube oils with a VI as high as 115. Oils of higher viscosity index are achieved by using additives known as VI improvers. These are of real value, not only in motor oils, but in hydraulic oils where favorable viscosity-tempera-

Deterioration due to oxidation is universal in petroleum lubricating oils. In the early years only lightly refined oils were used. In most cases these were high viscosity oils with inherently good stability, since the natural inhibitors had not been removed. And since the service to which the lubricants were exposed was not particularly severe, no urgent need existed for oxidation inhibitors.

ture characteristics are required.

But as operating conditions became more severe and speeds increased, as in steam turbine lubrication, highly refined oils with added inhibitors became a must. Now many industrial oils contain oxidation inhibitors, including hydraulic oils, spindle oils, transformer oils, circulating oils and instrument oils. Oxidation ir hibitors are also used in grease compositions, especially those for antifriction bearing applications.

► Corrosion Inhibitors—This term can refer to two distinct types of inhibitors designed to perform widely different functions. The first class might be more correctly named rust inhibitors and are added to oils used in circulating systems of turbines, hydraulic systems and machine tools where rusting of steel pipes, sumps and bearing houses must be prevented. The other type are those used in crank-case oils to minimize corrosion of bearing metals.

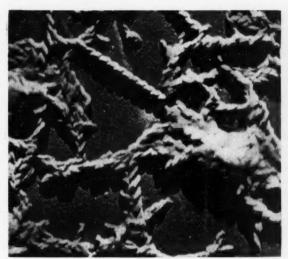
Considerable difficulty has been experienced from corrosion of cadmium-silver and copper-lead bearings in internal combustion engines. Two approaches to the solution of this problem have been taken. In one, oxidation inhibitors are added to prevent formation of acidic decomposition products which attack the sensitive bearing materials. In the other, bearing corrosion inhibitors are used to passivate the action of the acidic products. Many times these properties are combined in one product.

Detergent-Type Additives—These may generally be though of as chemical compounds added to oil to keep unburned carbon particles and other contaminants from depositing on various engine parts. By keeping them in suspension, it is possible to draw off the undesirable material with each oil drain.

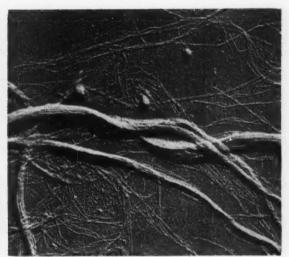
► Tackiness Agents—Increasing the cohesiveness of a lubricant reduces drip and spatter, minimizes waste. This property, often referred to as tackiness, is important in service conditions where the lubricant is not mechanically held in or returned to the bearing.

The action of such agents is to produce an adhesive oil film on the journal and bearing metal surfaces. This acts directly to hold the oil on the metal and retards oil leakage. Such additives are also used in chassis lubricants and other pressure-applied greases, particularly those subjected to severe shock leads.

▶ Antifoam Agents—In lubricants designed specifically for gear case systems, hydraulic and other circulating systems, there exists the possibility of foaming, either because of extreme pressure agents or oxidation products present in the oil. Fortunately this can be virtually eliminated by using as little as 0.005 percent additive.



TWO STRAND rope-like calcium tallowate typifies cup greases. SHEAR STABLE soda fibers split into fibrils when worked.



are a mechanical mixture of soap, oils and water. At elevated temperatures water tends to evaporate, allowing the oil to separate readily and bleed away from the bearing. This leaves a heavy, sticky mass of soap that soon causes difficulty, especially in antifriction bearings.

Calcium base greases are of assistance when a lubricant is required for temperatures from about freezing to well below 0 deg. F. In selecting a calcium grease for low temperature lubrication, viscosity, viscosity index and pour point of the oil used are extremely important.

Aluminum Base Might Gel

Aluminum soap greases are very similar to calcium soap greases in their general structure, physical characteristics and uses. However, care must be taken when aluminum base greases are used over an extended period of time near their melting point and then allowed to cool quickly, as on shutting down. When cooled rapidly they have a tendency to set up in a stiff gel structure that will no longer wet metal surfaces. Loss of lubricating value results. This can be overcome by frequent periods of relubrication.

Soda Base for Heat

Normal soda base greases are sometimes called sponge or fiber greases. Like calcium greases, they are made from whole fats or fatty acids, water

and lubricating oils. But caustic soda is used instead of lime.

Soda grease is different from calcium grease in that it is more nearly a colloidal mixture of soap and oil and does not depend entirely on its water content to maintain a gel structure. In fact, an excess of water generally causes the grease to become soft and lose its normal consistency under operating or storage conditions.

The general outline for selecting a calcium grease can be closely followed for soda greases, with the exception that the latter are not so desirable at temperatures below freezing. They do give satisfactory lubrication at temperatures up to about 400 deg. F., but should always be questioned when used in contact with water or steam.

Another factor to take into consideration in the selection of a soda base grease is the general structural appearance, whether a short, buttery type or a long, stringy, fibrous type. Short, buttery fibers are usually more desirable for antifriction bearings, and for general sleeve bearing lubrication. In application such as flexible couplings and universal joints, where throwoff due to centrifugal force is a factor, longer fibers are better because they tend to wind around the moving part and resist throw-off.

One Grease: Many Uses

The newer multipurpose greases being marketed today are produced

mostly from barium and lithium soaps. The barium soap greases have generally short fibers, high water resistance and a melting point ranging above 400 deg. F. The fact that this grease has very little breakdown when worked puts it in the class of multipurpose grease.

The high temperature characteristics of barium grease are due to the fact that it does not have a sharp melting or dropping point. It merely thins out to a homogeneous fluid lubricant at elevated temperatures.

Lithium soap greases are similar in utility to barium greases, but differ in appearance and some general characteristics. They are smooth and buttery like the calcium greases, but melt above 300 deg. F. Their low temperature characteristics are somewhat superior to barium. However, water resistance is not as good as with barium greases, falling somewhere between calcium and soda greases.

Not Only Soap and Oil

Inorganic thickening agents with many desirable properties are also being used in grease making. Such greases boast high dropping points and show little change in body over a wide temperature range. Criticisms leveled at these materials are their relatively high cost and the tendency of some to lose structure when operating under high shear at room temperature.

Perhaps the newest developments in lubricating greases are the so-called synthetics. These products are produced by using normal type soaps, but substituting synthetic types of hydrocarbons for normal mineral oils. If your plant problem is one of wide temperature variations, rapid oxidaton, gumming, etc., the synthetic products would be of great interest, even though cost at present is much higher than for normal greases.

What to Look For

The two most important physical characteristics of a grease are penetration and dropping point. Penetration indicates the consistency or hardness of a grease and is generally expressed by the depth to which a standard cone-shaped weight will penetrate the grease under prescribed conditions. The lighter the grease the higher the depth of penetration and thus the higher the penetration number.

Grease Grade and Penetration

NLGI Grade*	Hardness	Penetration
0	Very soft	350-385
1	Boft	310-340
2	Medium soft	260-300
3	Medium	220-250
4	Hard	175-205

*National Lubricating Grease Institute.

The "worked" penetration of a grease gives an indication of its tendency to leak or drip from a bearing or its ability to flow under pressure in feed lines.

ASTM dropping point is the temperature at which the grease passes from a semi-solid to a liquid state. It is a qualitative indication of the heat resistance of a grease in applications where a semi-solid lubricant is required.

Typical Dropping Point Ranges

Grease Base	Dropping Point, Deg. F.
Calcium	160-210
Bodium	275-350
Lithium	350-400

Synthetic Lubricants

Due to certain superior properties, synthetic lubricants have gained wide-spread and justified interest in recent years. They can be broken down into several general types: silicones, polyalkylene glycols, diesters, organic chlorine compounds and polymer oils.

Silicones Have Many Uses

There is an increasing demand in the chemical industry for lubricants in applications where conventional oils have proven unsatisfactory. Silicone oils have come into their own because of such attractive characteristics as small change of viscosity with temperature, high temperature stability, low pour point, chemical inertness, good electrical properties and resistance to shear breakdown.

The behavior of the silicone greases under shear is similar to that of most organic greases. At low shear rates, the amount and type of soap is most important, whereas at high rates of shear, consistency is determined largely by the oil.

Functional tests indicate that silicone lubricants have good lubricating properties in either sliding or rolling friction, between plain or chrome-plated earbon steel and aluminum, brass, copper, copper-lead, bronze and tin-base babbitt. At elevated temperatures, silicone fluids are definitely superior to petroleum oils as lubricants with the metal combinations listed above. Where two ferrous metal surfaces must be lubricated, silicone fluids or greases are not satisfactory under heavy loads because boundary lubrication is apt to occur.

Silicone lubricants have long life in antifriction bearings operating at relatively high speeds under normal loads at temperatures from -100 to 375 deg. F. If bearings are relubricated regularly, the operating temperature can be increased to above 500 deg. F.

Note though, that in those temperature ranges where petroleum products can be used, their performance is generally better than that of the silicone lubricants. The latter are most useful where organic oils and greases stiffen at low temperatures, break down in corrosive atmospheres, bleed, evaporate or form gums at high temperatures.

Polyalkylene, Glycols Take Heat

In chemical plants, lubricating problems involving high temperatures are probably the most difficult to solve with conventional lubricants. Polyalkylene glycol lubricants offer two outstanding characteristics for such service: they tend to be somewhat more stable at elevated temperatures; and when they do undergo thermal decomposition resultant products are either similar to the original lubricant or are volatile and pass off without leaving tar or carbonaceous residue.

Besides high-temperature applications, these materials have found use in compressor, vacuum pump and internal combustion engine lubrication, and also as hydraulic fluids.

Chlorinated Organics Resist Fire

These materials are usually chlorinated biphenyls or polyphenyls and possess unique properties that enable them to fill requirements not met by other materials. They are soluble in most common organic solvents, thinners and oils, and are insoluble in water, glycerin and the glycols. They are all heavier than water.

Their excellent electrical properties, fire resistance and inertness have made them useful as non-flammable hydraulic media, high-temperature and high-pressure lubricants, sealing compounds and protective coatings. In the chemical industry they have found particular acceptance as high-pressure air compressor lubricants and as packing lubricants in pumps handling chlorinated products.

Polybutenes Burn Off Easily

These synthetic polymers are obtained by catalytic polymerization of normal and branch chain butenes. They are pale colored, chemically inert liquids of high viscosity and tackiness.

There are many applications for the polybutenes, either by themselves or combined with other materials. They produce a modifying effect and are used mostly in the manufacture of special industrial greases and gear lubricants, but also as viscosity improvers for lubricating oils.

They have been used, too, as lubricants in high temperature antifriction bearings where an ordinary lubricant would decompose. The polybutenes, instead of leaving a charred deposit, burn off and leave no residue.

Low Pour for Diesters

At the present time the diesters are enjoying a large volume usage among the synthetics. This is because a number of them have been produced with a combination of properties desirable in low-temperature applications. The

most promising have pour points ranging from -40 to lower than -100 deg. F.

In general, the use of the more expensive synthetic lubricants is predicated on the basis of either superior high-temperature properties, superior low-temperature properties or exceptional lubricating value at normal temperatures. So far they have been used principally as instrument oils, hydraulic oils and in low-temperature greases.

Solid Lubricants

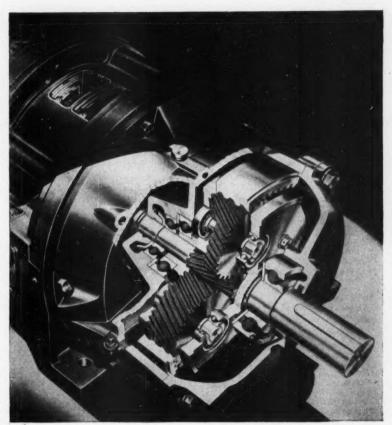
In man's search for a better lubricant, several solids such as graphite, mica, salt, zinc oxide and molybdenum disulfide, have been found to possess lubricating properties. The three most common materials, natural graphite, synthetic (electric furnace) graphite and molybdenum disulfide will be discussed here.

 Natural graphite is a dry lustrous mineral used either alone or mixed with oil or grease. It has been used in the manufacture of oil-less bearings, as a paste, in solid rods or combined with powdered metals.

• Synthetic graphite is manufactured in electric furnaces from anthracite coal and petroleum coke. It is a soft, greasy substance, almost chemically pure, and its structure is identical to that of natural graphite. The fundamental difference is in particle size, with synthetic graphite falling in the colloidal range. It can be used dry or mixed with water, mineral or synthetic oils, or other carriers.

 Molybdenum disulfide closely resembles graphite in structure, but is twice as dense. Like graphite, it forms oriented layers on the surfaces that slide easily over each other. Molybdenum disulfide is a good hightemperature lubricant up to the point where oxidation takes place—about 600 deg. F.

Solid lubricants are most effectively, used where conventional lubricants are not suitable, such as on slow-speed equipment where an oil or grease film cannot be obtained or where contamination may result through use of an oil or grease. A point to remember about solid lubricants, though, is that they are worthless when added to an oil or grease if the oil or grease can do the job alone.



How to Lubricate Your Equipment

Whether you have a pump or a kiln, a filter or a mixer, ! !ubrication needs boil down to basic machine elements.

No two chemical plants are exactly alike in regard to the manufacturing equipment they contain. There are almost unlimited numbers of processes and plant layouts for making the same chemicals. A kiln can perform the same function one place that a conveyor type dryer does in another. Or a gear type pump can handle the same material in one plant that a reciprocating pump does in another.

The subject of lubrication can be simplified by classifying chemical manufacturing equipment into general categories, such as conveyors, crushers, mixers, dryers, etc. To further simplify, each piece of equipment is made up of basic machine elements that must be lubricated—bearings, gears, chains and sliding surfaces.

Therefore, the problem of lubricating chemical plant equipment is one of lubricating basic machine elements in the adverse operating conditions found in chemical plants (see *Table I*).

Plain Bearings

Plain bearings are either cylindrically shaped to carry radial loads or flat surfaced and mounted perpendicular to a shaft to carry thrust loads. They are made of bronze, aluminum, silver, babbitt, plastics, ceramics, wood or carbon.

Mounted concentric with shafts or journals, plain radial bearings carry the loads imposed on the shafts and accurately maintain the shaft location. The equipment designer is responsible

Table I—Typical Lubricated Equipment Components

	Bear	ings	1	Gears			
	Ball or		Spur, Helical			Drive	Sliding
Chemical Plant Equipment	Roller	Plain	or Bevel	Worm	Open	Chains	Surfaces
Agitalon -			11,12				
Paddle		×	×	X	×		
Gete		×	×	×	×		
Propeller	×	×	X	×			
Blowers and fens	×	×					
Clarifiers and thickeners	×	x	×	×		×	
Compressors		-	•				
Centrifusal	×	×	×				
Reciprocating	x	×	-				×
	^						
Conveyors -		×					
Screw	X	-	×	X		X	
Belt	X	×	X	X		×	
Flight	×	×	×	X		×	
Dreg	X	X	X	×		X	
Bucket elevator	X	×	×	×		X	
Chain	X	×	X	X		X	
Crushars							
Gyretery	X	X	×				
Jow		×					
Roll		X					
Hammer mill		×					
Rotery		X		X			
Red mill		×	×				
Pabble mill		×	X			x	
Ball mill		×	×			×	
Crystallizers	×	x	x	×		×	
	•	^		•			
Dryers-	×	×	×	×	×		
		â	x		*	×	
Flash	×			×		×	
Conveyor	X	×	×	×		×	
Pan	X	×	×				
Filters							
Press		X		×	×		X
Rotary	×	X	×				
Centrifugal	×	X	X				
Gearmotofs	X	X	×	X			
Moton	×	×					
Mixers							
Sweep		×	×	×			
Paddle	0 : 9 4	×	×	X			
Screw		×	×	×			
		×	x	×			
Pon.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		- ^	_				
Pumps-							
Centrifugal	×						
Gest		×					
Reciprocating	×						×
Vane		×					
Screens		1-0-					
Revolving	X	X	X				
Reciprocating	×	×	×	×	Tellies !		X
Gyretory	X	×	X	×			X
Vacuum Pumps							
Reciprocating	×	X					X
Rotery	X	X					1 3 3 3 5
Vane	X	×					

for selecting the correct type-either a rigid radial bearing that is constrained and cannot move in its housing or a self-aligning type that can move to accommodate shaft misalignment. Plain thrust bearings are the tapered land, step or tilting pad type.

Oil Lubricated

Metallic plain bearings are the most common plain surface bearings of concern to chemical plant lubrication engineers. They can be found on practically any type of chemical manufacturing equipment. But despite the many types of plain bearings in use, all use the same basic lubrication practices. The most influential operating conditions are speed and temperature. Look at the ZN/P curve on page 213. As stated before, if the value of ZN/P for a plain bearing falls above point B the bearing is operating hydrodynamically on a full-fluid film of oil.

When V = viscosity in centipoises at the operating temperature, N = speed in rpm., P = load in lb. per sq. in. of projected bearing area,

typical design values for various types of bearings are: large industrial bearings-15 and higher; small bore rigid bearings—5 to 10; very fine finish precision bearings—1 to 5.

The ZN/P relation shows that at high speed a plain bearing will carry a much heavier load with the same viscosity oil than it will at a lower speed. As a result, light viscosity oils are used in plain bearings on turbines, spindles, centrifuges and other highspeed equipment. Heavier, high viscosity oils are required in the plain bearings of crushers and other lowspeed equipment.

In order to maintain the correct

Characteristics of Metallic Plain Bearings

Advantages

- Good for shock loads.
- Very low coefficient of friction when operating on a hydrodynamic oil film.
- Quiet in operation.
- Low first cost.
- Seldom subject to fatigue failure.

Disadvantages

- . High starting friction.
- · Plain radial bearings cannot take thrust loads.

Table II—Typical Oil Viscosities: Plain Bearings

Oil Viscosity,
SUS at 100° F.
2,500-3,500
1,400-2,500
800-1,400
500-800
300
150
90
60

ZN/P relationships, a higher viscosity oil must be used:

- As operating temperatures increase and the lubricant becomes thinner.
 - · As load increases.
 - As speed decreases.

The oil viscosity for a properly designed plain bearing can be selected on the ZN/P basis from Table II if the operating temperature is not materially above 140 deg. F. When temperatures above this are encountered a good general rule is to use an oil that will have a viscosity range, at the operating temperature, of 75 to 100 SUS.

When consistently higher temperatures are encountered—above 160 deg. F.—a circulating oil system with an oil cooler is often used. To properly protect the bearing these systems should also have a filter for removing oxidation products, water and sludge.

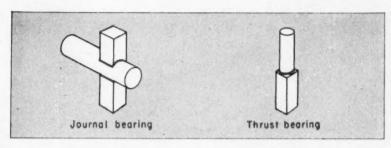
When selecting a plain bearing oil, quality must be considered as well as viscosity. Use the guide shown in Table III.

Grease Lubricated

On large, slow-moving equipment, plain bearings are usually grease lubricated. Greases have considerably higher shear resistance than oils and therefore can support the higher loads and lower speeds encountered. Typical chemical plant equipment of this type includes crushers, mills, kilns, conveyors, mixers and large filters.

Soft, calcium base greases are usually the best for plain bearings. NLGI No. 0 or No. 1 grades are the most widely used. These soft greases are preferable because they tend to cover the bearing surface, yet are sufficiently tacky to resist leaking out of the bearing. Chemical adhesive agents are sometimes used to impart additional adhesion and cohesion.

To meet production schedules, chemical plant equipment is often run above normal speeds and loads. In such cases plain bearings often fail. If there is not sufficient space to install a larger size bearing, a change of the type of grease, usually to an extreme pressure grease, will often prevent trouble. One of the most common is a calcium base grease containing a mild EP additive, such as lead soap.



Since calcium base greases are usually not stable at temperatures above 150 deg. F., sodium base greases are usually recommended at temperatures up to 300 deg. F. and mixed sodium-calcium base greases at temperatures up to 250 deg. F. Silicone greases are widely used in plain bearings operating at temperatures above 300 deg. F.

Selection of synthetic greases is based on one or more of the following factors:

- Correct viscosity to operating temperature relationship.
- Lubricant does not adversely affect the product.
- Product does not adversely affect the lubricant.

Synthetic Fluid Lubricated

There are some chemical operating conditions under which petroleum base oils cannot be used in plain bearings. One such is when temperatures are well above 200 deg. F. Another is where process material and lubricant come in contact and the product either breaks down the petroleum or is contaminated by the oils.

In general, though, petroleum oils are much preferred to synthetic fluids for plain bearing lubrication. They are much better surface wetting agents and have superior inherent lubricating qualities or "lubricity." In addition, they are much less expensive.

Water Lubricated

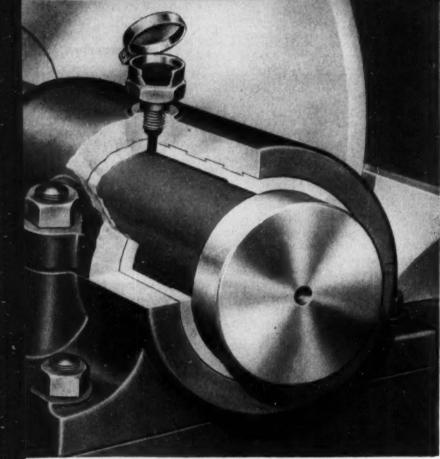
Nonmetallic plain bearings are usually lubricated by water or by the process fluid which the equipment is handling. When properly designed, these bearings give excellent service. In many instances they will function efficiently where an oil or grease lubricated metallic plain bearing could not be made to operate.

One example is the submerged ceramic bearing of a vertical pump handling a water-like fluid that contains a high concentration of abrasive particles (p. 222). In this instance, the bearing is made of sintered aluminum oxide and the shaft is stellited.

Nonmetallic plain bearings are being used successfully where they are required to operate in aqueous

Table III-Quality of Oils: Plain Bearing Lubrication

Name	Туре	Additives .	Remarks
Mechine or "squirt-can"	Naphthenic base	None	Cheapest. Good for streight-through service where oil is retained in bearing for only a short time. Has low VI and poor resistance to oxidation.
Quality industrial	Solvent refined inixed or paraffin base	Oxidation and corrosion inhibitors	High VI and oxidation resistance. Good where bearings and geers are commonly lubricated with the same oil.
Turbine or hydraulic	Highly treated sol- vent refined mixed or naphthenic base	Rust and oxida- tion inhibitors (sometimes con- tain an antifoam agent)	High VI and oxidation resistance. Ordinarily gives best service and has longest life.
Refrigeration	Dewaxed naphthenia	None	Used where bearing operates below 0 deg. F. and oil is in contact with a refrigerant.



OIL LUBRICATED plain bearings use light viscosity oils when run at high speed.

solutions. Bearings made of glass fiber filled with Teflon* are being used in both concentrated and dilute nitric acid pumps and are actually lubricated by the acid.

However, insufficient surface speed is a common stumbling block to successful operation of sleeve bearings lubricated with low viscosity fluids, such as water. These bearings are usually made of rubber or phenolic resins and a surface speed of about 500 ft. per min. or higher is necessary

• Tetrafluoroethylene resin.

to generate sufficient shear resistance in the light fluid to carry a load.

Nonlubricated

Nylon is finding wide acceptance for use in nonlubricated plain bearings. Nylon sleeve bearings work extremely well without any lubrication when loads are not too severe. This characteristic is very important in the manufacture of materials such as pharmaceuticals and textiles where the product must not be contaminated by oil or grease. Many of the sleeve

bearings on synthetic fiber manufacturing equipment are now being made of nylon and operate efficiently without Jubrication.

Sleeve bearings made of glass fiber filled with Teflon are also being used in the same types of application as the nylon bearings. In addition to low coefficient of friction. Teflon has the important characteristic of chemical inertness. Thus these bearings are finding many uses in severe chemical service.

Carbon or graphite bearings have been widely used in nonlubricated chemical plant service for several years. These work well in operating conditions involving high speed and low loads. They are also used successfully when immersed in water.

Rolling Contact Bearings

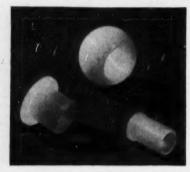
Rolling contact bearings are usually called antifriction bearings. This is a misnomer, though, since they are subject to the rolling friction of the balls or rollers on the races and to the sliding friction of the cages or spacers.

Rolling elements can be either balls or rollers. Ball bearings are classified as deep groove, thrust, angular contact and self-aligning. Roller bearings are cylindrical, tapered and spherical.

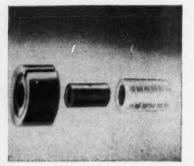
Oil Lubricated

As in plain bearings, the most important factors to be considered in the selection of an oil for rolling contact bearings are speed and tempera-ture. Table IV shows typical viscosities of ball and roller bearing oils.

The table covers the condition of bath lubrication where the oil is retained in the bearing housing. If



SINTERED ALUMINUM OXIDE . . . NYLON with or without oil and . . .



TEFLON outperform metals in some uses.



continuous temperatures above 200 deg. F. are encountered, a circulating system with an oil cooler and filter should be used. When speed factors above 300,000 are encountered, oil is usually supplied as a mist.

The types of oils normally used for ball and roller bearing lubrication are the same as those shown for plain bearings in Table III (page 221). Naphthenic base oils should be avoided for temperatures above 150 deg. F., since they have low VI and poor oxidation resistance.

The use of high VI, rust and oxidation inhibited turbine or hydraulic oils is recommended for long oil life and top bearing performance. In applications where ball or roller bearings and gears are lubricated by the same oil, quality industrial oils will give excellent service.

Synthetic lubricants are applicable to ball and roller bearings in the same applications discussed for their use with plain bearings.

These precautions should be taken in the operation of all oil lubricated bearings:

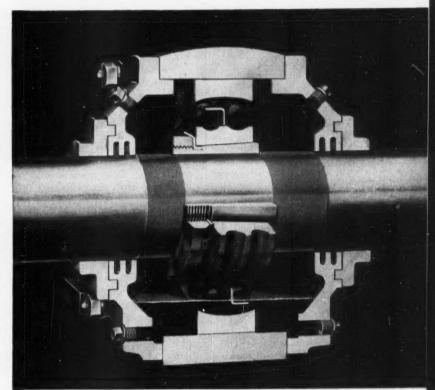
- Use the lightest oil possible commensurate with operating conditions.
- Use as little oil as possible.
 In a bath lubricated bearing the oil level should not be above the center of the lowest ball or roller.
- Use a rust and oxidation inhibited oil to protect the finely finished bearing surfaces and to obtain maximum oil life.
- Maintain seals adequately to keep oil in and dirt out.

Grease Lubricated

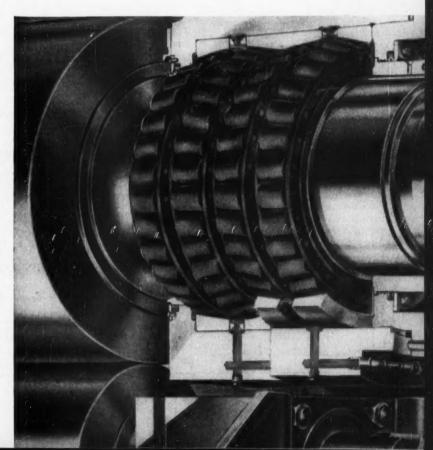
Grease is probably used more often than oil for lubricating ball and roller bearings in chemical plants. It can be used to lubricate spherical roller bearings having speed factors up to about 100,000. Other types of roller and ball bearings can be grease lubricated if the speed factor does not exceed 150,000. In higher ranges, oil must be used.

Here are some rules for operating grease lubricated roller and ball bearings:

- Do not over-lubricate. The bearing housing should not be over one-third full of grease.
 - · Keep grease clean and free of



ROLLING CONTACT bearings can be lubricated with oil (above) or grease (below).



Oil vs. Grease

The question often arises as to whether grease or oil should be used to lubricate bearings. Both can give satisfactory service. Here's what you should know to decide between them for any given application:

- · Grease lubricated bearings require less frequent attention than those lubricated with oil because of the "stayput" qualities of grease. This is particularly important when bearings are located in relatively inaccessible locations, such as elevator motors, hoists and cranes. The stay-put properties are also valuable because some lubrication will be provided even if the bearing is neglected for a considerable length of time.
- · Grease lubrication is preferred where freedom from dripping or spattering is important from a housekeeping and product contamination standpoint.
- · Grease frequently withstands severe operating conditions better than oil. High temperature for short periods of time, extreme pressure, low speeds, reversals in rotation and shock loads impose severe demands on the lubricant. Straight mineral oil cannot always lubricate properly under these conditions.
- · Since grease acts as a sealing medium and prevents materials from reaching the bearing surfaces, it is generally preferred on machinery operating under dirty, dusty or wet conditions.
- On the other side of the picture, grease does not form a complete lubricating film in all cases because of its heavier consistency. Also, the film of grease may have greater internal friction than the proper viscosity of straight mineral oil. Grease, therefore, is not as adaptable as oil to high-speed service or to other conditions where the power consumed is important.

Examples where oil is preferable are on steam turbine bearings, textile spindles and machine tools where lubricants can be circulated. Oil is also preferred where, in addition to lubrication, cooling action is required.

Actually, oils and greases are net completely interchangeable in equipment, either. With plain bearings, change of grooving is necessary. With antifriction bearings, certain modifications must be made to ensure that sealing will be adequate and that contamination cannot OCCUE

contaminants before it is placed in the bearing. Grease guns should be filled by filler pumps so that the cover is not removed from the container.

· Add fresh grease with the bearing housing drain plug open and the bearing running. The old grease will be drained out and the bearing will relieve itself of excess grease.

Sodium base or mixed sodiumcalcium base greases, having a NLGI No. 2 consistency, are the most widely used. Both types tend to reduce rust and can withstand the mechanical agitation received in ball and roller bearings. Electric motor ball or roller bearings, which are required to operate continuously for long periods of time, are almost universally lubricated with sodium-calcium or soda base greases.

Mixed base greases can be used in bearings operating at temperatures up to 250 deg. F. Sodium base greases can be used up to 300 deg. F. Mixed base greases are fairly resistant to water, while sodium base greases are seldom used in bearings exposed to an appreciable amount of water.

Straight calcium grease is not stable at high temperatures and the oil and soap tend to separate when subjected to mechanical agitation of a highspeed ball or roller bearing. Because it is resistant to leaching by water, however, it is used in low-speed, lowtemperature ball and roller bearings exposed to water.

Lithium greases are being used successfully in ball or roller bearings which are required to operate over a wide temperature range. Barium base grease is used when bearings are operating at very low speeds and at high temperatures ranging up to 300 deg. F.

Strontium base grease works very well in ball and roller bearings exposed to steam and operating at high speed and temperatures up to 300 deg. F. Silicone grease (silicone thickened with silica, lithium soap or carbon) is used in low-speed ball or roller bearings operating above 300 deg. F.

Sealed Bearings

Self-sealed ball bearings have many applications in chemical plant equipment. They are advantageous in that the lubricant is sealed in the bearing and dirt is effectively kept out. Inaccesible or dangerous bearing locations lend themselves readily to this type, as do operations that prohibit product staining by lubricants.

These bearings can be lubricated with either oil or grease. However, sodium or sodium-calcium greases are usually used.

Gears

Accurately made and finely finished gears made of many different alloys transmit the power and energy that

Characteristics of Ball and Roller Bearings

Advantages

- Low starting friction.
- Usually require less maintenance than plain bearings. Radial bearings can take a thrust
- Require little axial room.

Disadvantages

- Subject to fatigue failure.
- Require more radial space than plain bearings.
- Sensitive to shock and overload. Noisy, compared to plain bearings.
- Sensitive to moisture and acids.

Table IV-Typical Oil Viscosities: Ball, Roller Bearing

Average Viscosity, SUS @ 100°F.			
Operating below 150°F.	Operating 150-200°F.		
300-600	600-1,400		
150-300	300-600		
100-150	150-300		
60-100	100-150		
	Operating below 150°F. 300-600 150-300 100-150		

Table V—Typical Oil Viscosities: Enclosed Spur Helical, Bevel Gears

Pinion Speed, Rpm.	Application Method	Oil Viscosity, SUS @ 100°F.
Below 500	Circulation, spray or splash	1,400-2,500
500-1,000	Circulation, spray or splash	800-1,400
1,000-2,000	Circulation, spray, splash or mist	500-800
9,500-5,000	Circulation, spray, splash or mist	300-500
Above 5,000	Circulation, spray, splash or mist	150

makes present-day chemical plant possible.

And it's a fundamental fact that a film of lubricant must be maintained between the surfaces of the meshing teeth of a gear set to absorb tooth loads and prevent wear. This film must prevent metal-to-metal contact of the teeth or the gears will fail because of rapid wear. Correct lubrication, which ensures adequate separating films, results in long gear life and prevents breakdowns and lost production.

There are three main types of gears used in chemical plant equipment: enclosed spur, helical and bevel gears; enclosed worm gears; open gears.

Enclosed Spur, Helical and Bevel

Used for driving all types of chemical equipment, these are usually lubricated by petroleum base oils. In most geared speed reducers and increasers, bearings and gears are lubricated by the same oil. In some instances, however, the gear case and bearings—usually ball or roller—are separated by seals and the bearings are lubricated with a grease suitable for antifriction bearing service.

As in the case of plain bearings, speed and temperature are the most important factors influencing the selection of gear oils. About 80 percent of the gear sets in most chemical plants operate at temperatures of 100 deg. F., or less, while 18-19 percent operate in the range of 100-150 deg. F. Only 2 percent operate at temperatures as high as 300 deg. F.

The oil viscosities in Table V are based on operating temperatures up to about 160 deg. F. When higher tem-

peratures occur the oil from the gear case is usually pumped to a reservoir, then to an oil cooler and filter before being returned. An installation of this type is used to lubricate an agitator gear drive operating in ambient temperatures of about 200 deg. F., for example.

In addition to viscosity, the quality of oil must be correct for the particular gears in question. Here's how to choose:

• Inexpensive, low VI naphthenic base oils can be used if your operations are such that large quantities of acid and caustic cannot be kept out of the gear cases. The fact that these oils have low oxidation resistance and form sludge is not important since the gear case must be drained often anyway. Use of a high quality oil would be a waste of money.

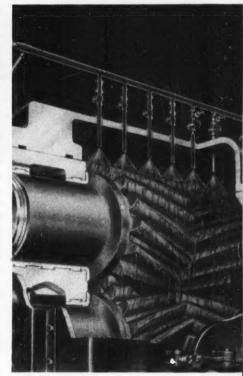
 Quality industrial oil, which has a high VI and contains oxidation inhibitors, is widely used for spur, helical and bevel gears. It gives very good service for a period of 6-12 months or more between changes.

• Heavy-duty motor oil can be used for periods up to 2 years or more between changes. This type of oil contains oxidation and corrosion inhibitors in addition to a detergent-dispersant additive. Even after the oxidation inhibitor has been depleted, it tends to keep any sludge that forms suspended in fine particles. As a result, when the oil is drained, the sludge particles leave the case with the oil and cleaning is minimized.

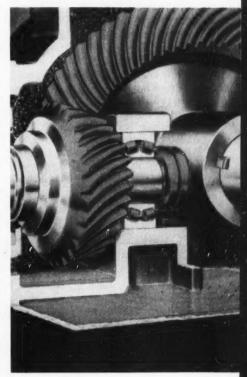
• Turbine or hydraulic grade oils are used in turbine reduction gears and increasers, as well as in other gear cases where oil is apt to be exposed to water. They give very satisfactory service since they are the highest quality industrial oils and contain oxidation, rust and foam inhibitors.

In many plants old equipment has been speeded up to meet production schedules and gears become overloaded, failing rapidly. This problem can sometimes be solved by using a higher viscosity oil, but frequently an extreme pressure oil is required. Usually an EP oil of the same viscosity is substituted for the original oil.

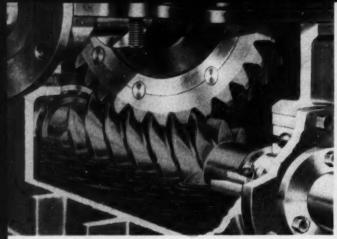
If operating conditions demand them, you can select synthetic lubricants for use in gears on the same basis as for bearing service.



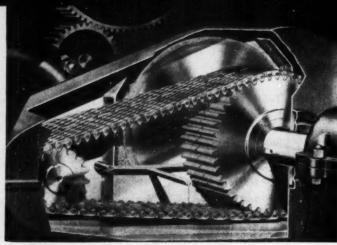
Double helical gears



Spiral bevel gear set







Enclosed Worm Gears

These are often used in chemical equipment drives, especially when large speed reductions are necessary between the driver and the driven equipment. Typical applications are agitators, clarifiers, dryers and other slow-moving equipment.

Because of the high tooth pressure involved and the sliding action of the worm and wheel, heavy oils are used. For operating temperatures from 60-140 deg. F., enclosed worm gears are usually lubricated with cylinder oils containing 5-10 percent of an oiliness agent-a fixed oil, such as acidless tallow oil. The viscosity range is 150-200 SUS at 210 deg. F.

You can use quality industrial oils with a viscosity of 1,200-1,400 SUS at 100 deg. F. if the worm gear is lightly loaded, or if the operating temperature is below 60 deg. F. They are also used if the unit is equipped with a circulating pump. If the operating temperature is above 140 deg. F., however, or if the equipment is heavily overloaded, an EP oil must be used. Normally, these oils have viscosities of 1;200-2,500 SUS at 100 deg. F. and contain lead soap.

Table VI-Typical Oil Viscosities: Drive Chains

Chain Spred, Ft. per Min.		Oil Viscosity, SUS @ 100°F.
Below 500	Oil both or drip feed oiler	500-1,000
500-1,000	Oil bath, mist or drip feed oller	300-600
1,000-1,500	Oil both or mist	300-600
Above 1,500	Forced feed circulat-	303-750

As in the case of enclosed spur, helical and bevel gears, enclosed worm gear units operating at very high temperatures should be equipped with an oil circulating pump, oil cooler and filter.

Open Gears

On many types of chemical manufacturing equipment, there are gears for which it is not practical or economically feasible to provide the necessary oil-tight housing which bath or splash-lubricated gears require. Such open-type gears must be lubricated sparingly to avoid dripping, untidy housekeeping and resultant accident hazards.

Some open gears are equipped with slush pans so that the gear teeth constantly receive a fresh application of lubricant. This type of installation is not too difficult to lubricate if you use high viscosity oils.

Many difficulties arise, however, when open gears have no slush pans and can be lubricated only sparingly and at infrequent intervals. In such cases, the lubricant is applied manually with a brush, paddle or by mechanical feeding. When relatively high surface speeds are combined with these meager lubrication applications, thin gear tooth separating films are likely to result and, in turn, boundary lubrication conditions. Therefore, an adhesive, tacky oil film is desired so that it is not easily squeezed out by the meshing of the teeth nor thrown off by centrifugal force.

Surface speed is the most influential operating condition affecting open gear lubrication. However, probably 80 percent of the open gears found in chemical plant equipment operate at

surface speeds below 500 ft. per min. Only in rare instances do surface speeds exceed 1,000 ft. per min.

Open gears are usually lubricated with the following types of lubricants:

• NLGI No. 0 or No. 1 calcium base grease containing a chemical adhesive agent. These have dropping points of about 190 deg. F.

· Straight mineral oil containing a chemical adhesive agent. The viscosity is usually in the range of 1,200-1,500 SUS at 100 deg. F.

· Very viscous products which are straight or solvent "cut-back" residual oils.

• Extreme pressure open gear greases, usually containing lead soap, or a metallic soap base grease with small particles of soft metal, such as lead, included.

Other Gear Types

The only industrial gear that has not been discussed is the hypoid, rarely used in chemical plant equipment. Hypoid tooth action is so severe that an active extreme pressure oil containing sulfur, chlorine and phosphorus must be used. These lubricants are classed as "all purpose" gear lubricants and can be obtained in a number of viscosity grades.

Drive Chains

Chains are often used to drive many types of chemical plant equipment, either in lieu of, or in conjunction with, gear reducers. The most common types of drive chains are roller, block and silent.

Viscosities of oil for lubrication of chains are shown in Table VI. The type or quality of oil can be selected on the same basis as for enclosed spur, helical and bevel gears.

Slow-speed chains, not enclosed in oil-tight casings, can be lubricated with NLGI No. 0 or No. 1 calcium base grease containing a chemical adhesive agent, or by an oil containing an adhesive agent. Viscosity should be in the range of 1,200-1,500 SUS at 100 deg. F.

Sliding Surfaces

Reciprocating motions in chemical equipment are usually produced by drive components which have sliding surfaces. Cams, ways and eccentrics are typical examples. If the sliding surface, such as a crosshead, operates in an enclosed oil bath, the oil can be selected on the same basis as for spur gears. If an oil bath is not used, the sliding surface must be oiled frequently by hand or continuously by means of a drip feed oiler.

For this reason, it is usually more practical to lubricate exposed sliding surfaces with grease. NLGI No. 0 or No. 1 calcium base greases, with or without an adhesive additive, perform well in this service. Addition of graphite or molybdenum disulfide to the

lubricant is beneficial if the sliding surfaces are heavily loaded.

Another example of a sliding surface is in an air compressor cylinder. The reciprocating surface in this case can be supported on an oil film. Naphthenic or turbine grade oils having viscosities of from 250 to 500 SUS at 100 deg. F. are generally used.

The use of too light an oil will result in wear, carry-over of oil spray in the discharge air and imperfect sealing. Operating temperatures and friction will increase if too heavy an oil is used, and deposits are likely to

Over-lubrication is the cause of most operating and maintenance troubles such as deposits (air-borne dirt in the oil), sticking valves, compression leaks, high temperatures and carry-over of atomized oil in the compressed air leaving the cylinder. Oil carry-over increases the likelihood of an explosion and also deposits oil on the aftercooler surfaces, thereby reducing heat transfer efficiency.

How Often?

Determining the amount and frequency of lubrication needed for your equipment need not be a problem if you follow a few basic rules.

In the first place, enough lubricant should be applied, but certainly not too much. It is generally not realized how frequently trouble is encountered through over-lubrication.

An example of this is in antifriction bearings where as many bearings have been lost through over-lubrication as from lack of lubrication. This is particularly important in grease-lubricated antifriction bearings where, with too much grease, excessive shearing occurs.

The question always in mind is: How frequently should the lubricant be applied? The answer, of course, depends almost entirely on the type of service.

If it is a "clean" service-located where contamination and excessive temperatures are not a problem—the time between lubrication applications will depend on the stability of the lubricant. On the other hand, many bearings operate in "dirty" servicedusty or corrosive conditions, with a possibility of extreme temperatures. In this instance, the frequency of relubrication is determined by how rapidly the lubricant is contaminated.

How to Get Lubricants Where They're Needed

There are innumerable devices used to get lubricants to the point of maximum value. These range all the way from simple oil cups to fully automatic systems, which, without attention, apply the correct amount of lubricant day in and day out. Here in outline form are the best methods for lubricating

various machine elements. We will not attempt a detailed description of the various items since it could make a report in itself. We feel, though, that such a listing as this should be reviewed whenever it is necessary for you to investigate methods of applying lubricants.

Journal Bearings

Plain bearings-low speed

Oil can, oil gun, grease cup Wick feed Grease gun Pressure grease cup Central systems Nonadjustable feed Adjustable feed Precision bearings Self-contained lubricant Splash Disk Ring or chain Circulating lubricant Internal External Circulating hydrostatic

system

Rolling Contact Bearings

High-speed—light load Wick feed Constant level Ring and chain Oil sealed Mist Central system Grease Grease gun Prepacked grease Low-Speed-high load Grease gun Central system Oil Grease Circulating lubricant system

Sliding Bearings

Guide bearings Brush lubrication Grease gun Central system Oil Grease Sight feed Pistons and cylinders Splash Hydrostatic line oller Pressure lubricator

Packings and Seals Packing Grease a Central system Oil Greese Pressure lubricator

Circulating system Seals Central systems Oil Greate Circulating lubricant

Gears and Chains

Open gears Sight feed Central oil or grease systems **Enclosed gears** Grease packed Pressure feed—gravity return Circulating system Mist

EQUI	PMENT	100	Telegraphic Company	LUBRICATION		REMARKS
Nome & Number	Part & Type	Points	Method	Lubp	Frequency	
Pump 7	Bearings, Antifriction	1	Maint, all level.	OILV	· Check weekly	Drain,chg annually
Agitator 19.1	Gear motor, Gearcase	1	Maint oil level	Oil B	Check monthly	Drain, chg-annually
RESERVED AND AND AND AND AND AND AND AND AND AN	Bearings, Plain	2	Gun	Grease A	Weakly	Market Market
	Packing gland	- 1.5	Gun	Grease D	Weekly	
Rotary filter 28	Geor reducer, Worm	11	Maint, oil level	OilC	Check weekly	Drain, chg.annually
	Bearings, Antifriction	2	Gun	Grease B	Monthly	
经产业的企业	Linkages	3	Manual	Oil D	Monthly	
Screw feeder 43	Chain drive, Roller		Maint oil level	Oil B	Check weekly	
	Gear reducer, Bevel		Moint oil level	OHB	Check weekly	Drain, chg. annually
HEREN THE STORES	Bearing, Antifriction	2	Gun	Grease B		
Steam tube dryer 76	Chain drive, Roller		Manual	Grease A	Weekly	SERVICE STATE OF STAT
	Gear & pinion, Spur	. 11	Monual	Grease A	Weekly	

You Must Schedule All Lubrication

Scheduling of lubrication is simply the establishment of a program for the application of proper lubricants at the proper time on an organized basis. Through scheduling of lubrication, at least two important maintenance functions accrue.

First, the type and quantity of lubricant applied throughout a plant is under control, resulting in reduced lubricant cost. Second, maintenance inspection of plant equipment on a periodic basis is obtained.

The man doing lubrication can provide, on his rounds, an inspection of parts and mechanisms necessary to prevent unpredicted major failures and equipment shutdowns. This feature of scheduling lubrication is not frequently recognized.

Actual methods of scheduling must be engineered to the specific plant and its physical size and layout. Large plants may use one or more full-time lubrication men with specific routes and time tables to ensure lubrication of all equipment at the proper frequency. Smaller plants usually provide a schedule for units or areas which are covered as a part of other work by the mechanics and operators.

Either system ensures that all parts of the equipment to be lubricated are indicated by the type of lubricant and the frequency noted. This is an important feature of any scheduling system and results in more continuous operation and lubricant control.

Use Your Laboratory

Most chemical plants have laboratory facilities that can be of real help to a good lubrication program. A few simple tests in the laboratory can tell much about the condition and usefulness of a lubricant.

In normal usage, lubricants deteriorate through oxidation. The acid or neutralization number is an index of the degree of oxidation. Unfortunately, unless a history is established in specific applications, spot checks do not give the whole answer. You usually have to follow the value of an acid number over a period of time, noting when the value starts to increase at a relatively rapid rate. Once it is on the up-swing, rapid deterioration of the oil can be expected. If a history is once established, however, spot values can then be used to indicate time to change lubricants.

Viscosity is another characteristic of oil that is easily checked in the lab. Although not as critical as the acid number, an upward viscosity change can mean oxidation, a downward change, dilution. The latter situation often occurs if a process material is soluble in an oil and is contaminating the lubricant.

The laboratory can also be of assistance in controlling the quality of the lubricants received. If equipment is critical as to the type and quality of lubricant, laboratory inspections of lubricants received can ensure that the proper material is used.

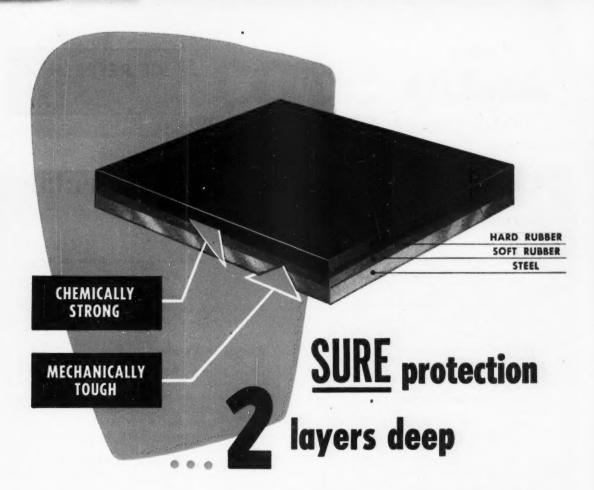
Acceptance tests for gravity, viscosity, color, flash point and dielectric strength can be established and will provide a basis for determining whether or not an oil is within the specifications expected. All these analyses are relatively simple and those of particular significance in the end use of the oil can be set as critical.

Analysis of grease is somewhat more difficult. Tests can be applied on new grease received, such as penetration, melting point and appearance. But there are no readily significant tests that can indicate the condition or forecast the life of the grease after it has been in use.

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Chemical Engineering Fundamentals

Introduction to Reaction Kinetics

THOMAS E. CORRIGAN, Research Engineer, Mathieson Chemical Corp., Brandenburg, Ky.

As a chemical engineer, you probably have been hearing frequent mention, in recent years, of the term "applied reaction kinetics." Many engineering schools have added courses in the subject to their curricula (both graduate and undergraduate). Many articles have appeared in the research journals on the subject. Industrial research departments, also research institutes, are beginning to devote more attention and money to the subject.

Questions which you might have asked yourself are:

· What is applied reaction kinetics?

· What is its purpose?

· How is it used for that purpose?

The term "kinetics" itself refers to the study of systems in motion. Reaction kinetics refers to the study of the principles of chemical reactions while they are in process. Applied reaction kinetics refers to the application of these principles to the solution of practical engineering problems.

To the mechanical engineer the principles of statics and kinematics are useful tools which are employed in machine design. The corresponding tools which the chemical engineer uses in process design are chemical thermodynamics and applied reaction kinetics.

For some time, the subject of reaction kinetics has occupied the attention of physical chemists as a tool for gaining insight into the nature of reacting systems; while its potential usefulness to chemical engineers (its application to process design and process development) has been generally overlooked.

But it is this application of reaction kinetics which has recently become recognized as a useful tool for process engineers.

What Is Applied Reaction Kinetics?

Specifically, applied reaction kinetics is the study of chemical reaction rates. Kinetics is the measurement of the rate of a chemical reaction. It is the determination of how that rate is affected by process conditions such as temperature, pressure and reactant concentrations. It is an attempt to formulate physical laws of nature which will correlate and explain the effect of the process conditions upon rate. And it is

an attempt to apply these laws by extrapolating them to other process conditions and other reactions.

What Is Its Purpose?

The purpose which the field of reaction kinetics serves is two-fold. It enables physical chemists to determine the mechanism of reactions and thus gain a better insight into the fundamental factors which cause chemical reactions to occur. It also enables chemical engineers to calculate the size of commercial chemical reactors.

Engineers use applied reaction kinetics for a single purpose: to design commercial-scale equipment to carry out chemical reactions.

How Is It Used?

The application of reaction kinetics to the design of a chemical reactor can be divided into two parts:

(1) A study of the chemical reaction to determine how each variable affects the rate. This leads to the determination of a rate equation.

(2) The application of this rate equation to the design of a chemical reactor.

The approach to a design problem involving kinetics may be compared with the approach used to design heat exchangers. When a heat exchanger is designed the first problem is to determine the heat transfer coefficient; the second is to use the coefficient to size the heat exchanger.

However, there are two major differences between heat exchanger design and reactor design. In the first case the general heat transfer equation, $q = U \Lambda \Delta T_m$, is applicable to all exchanger problems. The equations expressing the rate of a chemical reaction have a form depending upon the mechanism of the reaction. The chemical rate equation may be simple such as

$$r = kc_A$$

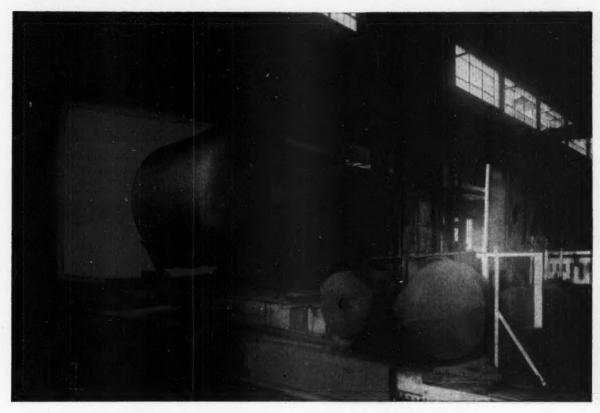
or complicated,

$$\tau = \frac{k \left[P_A - \left(\frac{P_R P_S}{K} \right) \right]}{[1 + K_A P_A + K_R P_R + K_S P_S]^2}$$

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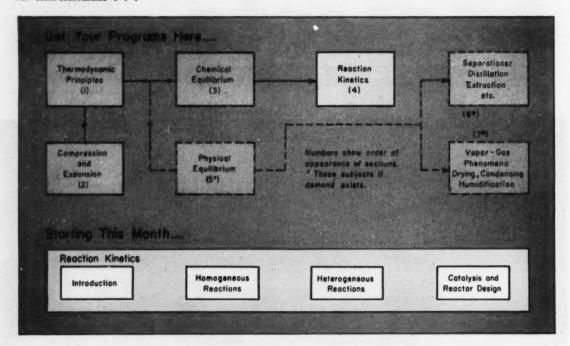
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The other major difference between heat transfer and kinetics is that a heat transfer coefficient can be calculated from physical properties and flow conditions, whereas a reaction rate constant can not be calculated. It must be measured experimentally for each chemical reaction.

If chemical reactions were well enough understood for us to predict rate equations and rate constants from our knowledge of the operating variables, it would be possible to design reactors without specific experimental data. But this is not the case and therefore chemical engineers must be concerned with the experimental determination of rate constants as well as with their use in reactor design.

Reactor Design

In many present practices of process development the process is brought through increasingly larger sizes—bench scale, pre-pilot plant, semi-commercial plant and production plant—in a more or less empirical manner.

The experimental data obtained in each of the experimental units is usually limited to questions concerning yields, corrosion resistance of the materials of construction, capacity and operating conditions—all obtained from actual experimental information. Many times the process is brought through all of the experimental stages by increasing size of units in an empirical manner, but without obtaining very much fundamental information about the reactions involved.

In this approach reaction rates are not measured and no attempt is made to determine a mechanism or to obtain a design equation. Instead, the total conversion is measured directly in the pilot plant reactor. The scale-up to commercial size is then done empirically. This approach gives no insight into the fundamentals governing the effect of each operating variable upon the reaction rate. Thus, every change of operating variables must be regarded as a separate case (since there is no fundamental relationship between the variables).

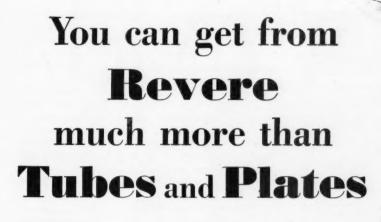
During the past several years the logical approach of first measuring the rate of the reaction, developing a rate equation and then using this equation to design reactors has been given considerable attention.

A judicious use of the principles of applied reaction kinetics during the laboratory and pre-pilot plant stages of development can yield enough fundamental information to allow us to predict by calculation the effect of a variety of operating conditions on larger units.

This may not eliminate the use of larger experimental units but it may be very useful in selecting the best process where several possibilities exist.

Development Time Can Be Cut

The science of process development has not yet reached the stage where enough fundamental data can be obtained on a bench scale in the laboratory to eliminate the need for a pilot plant; but the application of reaction kinetics principles can go far toward lessening the time spent in the later stages of development. When the cost in time and dollars of constructing and operating a large-scale pilot plant or a semi-commercial plant is considered, we can readily see that any informa-



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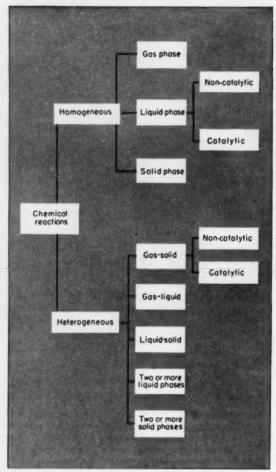


Fig. 1—Classification of chemical reactions based on the phases present.

tion on the effect of operating conditions which can be obtained with a pencil and slide rule, instead of experimentally, will effect a great savings.

Any Other Applications?

Two other applications where the principles of applied reaction kinetics may be useful are in preliminary costs estimates (made previous to the pilot plant stage) and in the prediction of a proposed change in operating conditions (such as temperature, pressure, recycle ratio and feed ratio) of already existing processes. For this reason applied reaction kinetics is useful to the planning and development group as well as to the technical operating staff.

Scope of Kinetics

The scope of kinetics is broad. It may be concerned with the rate of reactions in a petroleum refinery, the rate of growth of organisms in a biochemical process, the rate of decomposition of a radioactive material, the rate of transformation in a complicated mixture of silicates in a ceramic process, or the rate of an organic reaction in a high pressure autoclave. The principles are few and widely applicable.

The rate of a chemical reaction is influenced by many variables. Some of these are: temperature, pressure, composition of the reaction mixture, catalyst, velocity of reaction mixture and physical characteristics of each phase present. The subject of kinetics includes a study of the effect of all these variables upon the rate of a chemical reaction.

Regardless of the application, the two major factors to be considered are:

- The rate of the reaction
- The method (mechanism) by which the reaction takes place.

Classifying Chemical Reactions

The methods of obtaining this information vary widely and depend upon the type of reaction involved and the manner in which the reaction is carried out.

The types of reactions can be classified roughly as homogeneous when only one phase is involved or heterogeneous if more than one phase is involved. There are also sub-classifications under these major groupings. We have outlined a complete classification in Fig. 1 (above).

We can also classify chemical reactions according to the type of equipment used as the reactor. Such a classification might be:

- (1) Batch reactor
- (2) Semi-batch reactor
- (3) Flow reactor
 - a. With complete mixing
 - b. Longitudinal

The laws of physical diffusion are important to kinetics. In the case of heterogeneous reactions the rate of mass transfer from one phase to another may be just as important as the rate of the chemical reaction kinetics is not complete without including a study of those principles of mass and heat transfer applying to the diffusion processes that occur with a heterogeneous reaction.

In systems where gases react on a solid catalyst surface, the rate of diffusion to the catalyst or into the pores of a catalyst pellet may be more important in determining the capacity of a catalytic reactor than the rate of the chemical reaction itself. In a highly exothermic or endothermic reaction the heat transfer characteristics of the catalyst bed could be the most important factor in determining the value of a given catalyst for the process.

The rate of diffusion and heat transfer in either or both phases of a reaction involving two liquid phases (or a liquid and a solid, or liquid and a gas) could have as much bearing on equipment size as the rate of the chemical reaction itself. A study of kinetics must,



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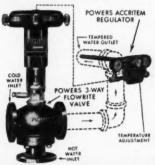
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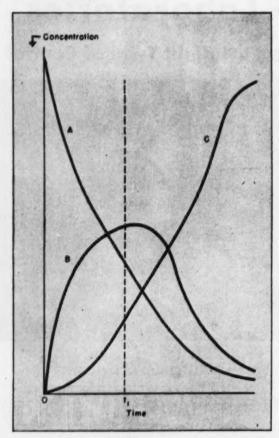


Fig. 2—Kinetic data may show that by quenching a reaction economic recoveries are feasible.

therefore, contain some of the aspects of heat and mass transfer as well as a study of the rates of chemical reactions.

Comparison of Kinetics and Thermodynamics

There is a fairly close relationship between reaction kinetics and thermodynamics. They both involve the effect upon reacting systems of such fundamental factors as temperature, pressure, and composition of each phase of the system. Their differences, however, exceed by far their similarities.

Thermodynamics is concerned with the composition of the system after it has come to rest; or, in other words, the goal that the system will approach if given infinite time. Kinetics is concerned with the composition of the system at any given instant during the approach to that goal. Thermodynamics is not concerned with time. In kinetics, time is a major variable. Thermodynamics will yield no information as to the nature of the path traversed to reach a certain goal, while kinetics is a study of the path (mechanism) traversed as well as the rate of approach to the goal.

Since kinetics deals with the added topics of rate and mechanism, kinetic data are considerably more difficult to obtain than thermodynamic data. This is compensated by the fact that kinetic data yield information which is considerably more valuable.

Consider, for instance, a case where a chemical reaction of the type

$$A \rightleftharpoons B \rightleftharpoons C$$

is to be carried out in a batch reactor. The desired product is B and the process engineer wishes to know if enough B can be recovered to make the process economically feasible.

He may evaluate the thermodynamic constants and from these find that the mixture at equilibrium will contains only 1 percent of B. From this information he might decide that the process is not feasible, yet from kinetic considerations he might find that a plot of concentration versus time in the batch would be shown as in Fig. 2.

If the reaction were quenched in time t_i , the concentration of B in the resulting mixture would be sufficiently high to warrant its economical recovery. Here the use of thermodynamics alone would have led the process engineer to a false conclusion.

Kinetic Data Harder to Find

The science of thermodynamics is much more fully developed than that of kinetics. Thermodynamic data have been obtained on many substances and the equilibrium constants have been determined experimentally for many reactions. In contrast to this, the rate constants have been determined for relatively few reactions.

By its very nature thermodynamics is not concerned with the path of a process and this, as noted by the wide application of Hess' law, makes it possible to determine the equilibrium constants of a reaction without necessitating a direct study of that reaction itself. The constant of one reaction can be obtained from a study of two other reactions.

For instance, if K_1 and K_2 are measured for the reactions below, K_3 may be calculated as indicated:

- (1) $CH_4 + H_2O \rightleftharpoons CO + 3H_2$ K_1
- (2) $CO + H_2O \rightleftharpoons CO_2 + H_2 \qquad K_2$
- (3) $CH_4 + 2H_2O \rightleftharpoons CO_2 + 4H_2$

then by Hess' law,

$$K_3 = (K_1)(K_2)$$

Reaction rate constants can not be handled in this manner at all.

Equilibrium constants can also be calculated for a given reaction (if standard heats of formation, absolute entropies and heat capacity data for each of the products and reactants are tabulated in the literature) without recourse to experimental data on the particular reaction under consideration.

The approach of the engineer to a problem involving the use of kinetic data, therefore, must of necessity be different from his approach to a problem in a field

A "cushioned" porcelain-to-porcelain seal in the Lapp Valve

The chemical resistance qualities of the Lapp Valve come from the fact that the body and plug are both solid porcelain. Porcelain, as a material, however, has little resiliency or "give" when the plug hits the seat in the body. Special spring-loaded "cushion" seating in Lapp valves prevents damage from a heavy-handed operator, and warns when seal is tight. Built into the thrust bushing of every Lapp Y-valve and angle valve, is an arrangement of tempered Beryllium copper spring washers. This spring loading also provides that a closed valve will maintain its tightness even under vibration and thermal movement of parts.



such as heat transfer, distillation or thermodynamics. He must know how to obtain the kinetic data as well as how to use them.

As a matter of fact, the laboratory scale or small pilot plant experimental work may serve as an excellent source for these data if the experiments are planned and executed correctly.

Because of this necessity for the data to be obtained on each individual system, the engineer must be well-versed in the techniques of obtaining kinetic data as well as in its application. An attempt will be made to present (in future installments) logical methods of obtaining the experimental data both on bench-scale and on pilot-scale experiments. The planning of experiments and interpretation of data in a manner so as to obtain information which is useful in the extrapolation to larger scale equipment will be emphasized. Also we'll point out how data can be obtained which will give us greater insight into the fundamental mechanism of the reactions.

Greater emphasis, however, is placed upon that phase of the subject which is of primary importance to the engineer—the application of the principles of kinetics to reactor design and to process design.

Application to Reactor Design

Once the kinetics of a reaction is known, the size reactor needed for any set of operating conditions can be calculated. However, the reactor design problem is much more complex than, for example, a heat exchanger design problem. Here's why:

Reaction rate is determined by complicated relationships of the variables.

• Frequently more than one reaction is involved.

 A physical process, such as diffusion, may be a major factor in determining the chemical reaction rate.

The last factor above is especially important in the case of catalytic flow reactions. Here the rate of diffusion to or from the catalyst surface may be the sole factor which determines the reaction rate.

The effect of temperature is an example of the complicated relationship between reaction rate and operating variables. In a commercial flow catalytic reactor the temperature distribution depends upon the heat transfer characteristics of the catalyst as well as of the reacting system. It also depends upon the flow rate, heat of reaction and reaction rate.

You'll Need Your Thermodynamics

One of the most important factors affecting the rate of a chemical reaction is the driving force of the reaction—that is, the displacement from equilibrium. The calculation of equilibrium conditions, of course, lies in the field of thermodynamics.

For this reason a brief review of the principles of thermodynamics is appropriate for a thorough understanding of kinetics. The index below will tell you where to find our previous discussions on thermodynamics. A brief background of some of the physical and chemical aspects of kinetics is also helpful to the chemical engineer who wishes to become familiar with the applications of reaction kinetics.

What We've Introduced

In summarizing this introduction then, applied reaction kinetics is a study of the effect of operating variables upon the rates of chemical reactions. The primary value of applied reaction kinetics to chemical engineers is its use to design commercial chemical reactors.

The primary tool that reaction kinetics provides the engineer for this purpose is the complete rate equation which is used for reactor design. The main problem for the engineer is to obtain the rate equation including values for all the constants it contains and to apply this to the design of the reactor. These two steps will be the primary theme of the series on kinetics.

In covering the points mentioned above the series will also attempt to give a brief historical development of the field of chemical kinetics as well as a survey of some of the theoretical aspects of the kinetics of both homogeneous reactions and of heterogeneous reactions.

NEXT MONTH

Kinetics of Homogeneous Reactions-(I) will discuss some of the different types of homogeneous reactions, the law of mass action, order of a reaction, mechanism of a reaction, how to determine the order of a reaction, and will give some working examples.

CE REFRESHER INDEX

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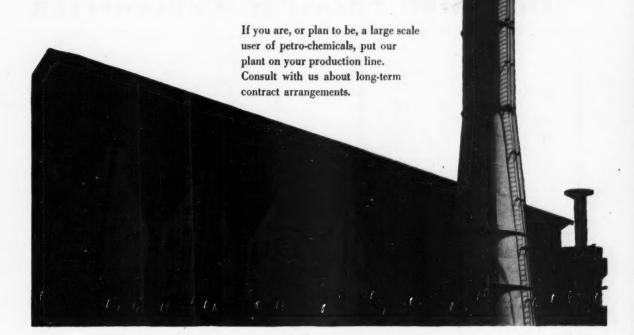
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Thermodynamics	. Reprint	No.	42
Compression-Expansion			
Chemical Equilibrium	Reprint	No.	49

The hottest spot in

town

This 170-foot stack at the National Petro Ethylene Plant serves ethane-cracking furnaces operating at temperatures in excess of 1500° F. The largest installation of its kind in the world, this plant was designed and constructed by The Lummus Company, New York. It produces 200 million pounds per year of ethylene from petroleum gases for further processing into ethyl alcohol, diethyl ether and ethyl chloride. In 1955, polyethylene will be added to the list of National Petro's ethylene derivatives, and still others will be produced as the demand for them continues to increase.



NATIONAL PETRO-CHEMICALS

A joint enterprise of National Distillers Products Corporation and Panhandle Eastern Pipeline Company
120 BROADWAY, NEW YORK 5, N. Y.

Now you can measure pressures WITHIN 1/4 OF 20-40 PSI SHIFTABLE RANGE SPANS



The Taylor TRANSAIRE* Pressure Transmitter with short, shiftable spans gives accuracy and sensitivity never before thought possible plus the convenience of suppressed ranges at high pressure levels. Operating on the simple force-balance

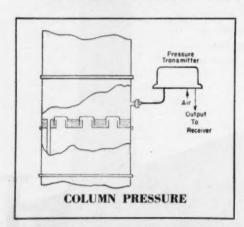
principle, it lets you measure and transmit minute pressure changes up to 1,000 ft. It's accurate to ½% of the selected short range span, as against an accuracy of up to ½% of the upper range limit of conventional devices. On control applications such accuracy of measurement produces a remarkable difference in product quality and yield. It's sensitive to pressure changes of ½" water.

THREE IMPORTANT ADVANTAGES

- 1. Range spans of 20 and 40 psi are available throughout the range limits of 35 to 415 psia; 50 to 100 psi throughout 100 to 1,000 psia.
- 2. The volumetric type pressure system is extremely accurate, practically clog-proof, has a corrosion-resistant 316 stainless steel diaphragm.
- 3. Temperature and barometric compensation makes for higher accuracy of measurement, and consequently closer control.

Ask your Taylor Field Engineer, or write for **Bulletin 98097.** Taylor Instrument Companies, Rochester, N.Y., and Toronto, Canada.

TRANSAIRE PRESSURE TRANSMITTER

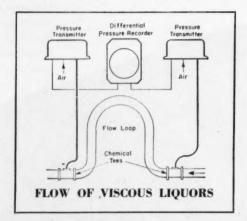


NARROW RANGE SPAN DETECTS PRESSURE TRENDS

Preblem: To get highest possible purity of product consistent with good production economy. This requires the quick detection of pressure trends over a very narrow range.

Solution: The short, shiftable range spans (as short as 20 psi) of the TRANSAIRE Pressure Transmitter permit selection of operating range by a simple screw-driver adjustment. Its high order of sensitivity enables the operator to detect minute changes of pressure.

Result: Close control, because the minute pressure trends are practically instantaneously detected and transmitted to the controller and receiver. This means higher yield of a purer product, also great flexibility in changing to different product requirements.



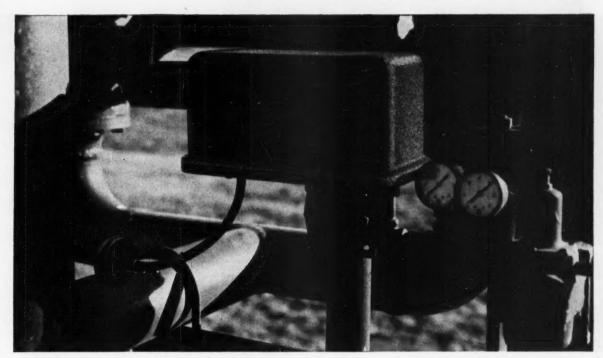
STREAMLINED SURFACE PREVENTS SCALE, SOLIDIFICATION

Problem: Flow measurement of viscous material which tends to solidify when static, making conventional differential producers impractical.

Solution: Its flush element presents a streamlined surface and tends to prevent formation of scale or solidification of liquors. Its short range, high sensitivity and volumetric construction make the TRANSAIRE Pressure Transmitter ideal for this application.

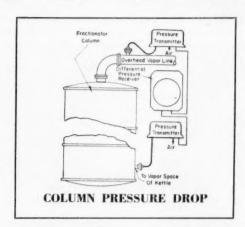
Result: Trouble-free, accurate measurement and control of flow. One installation has given continuously satisfactory service for four years.

*Reg. U.S. Pat. Off.



Typical installation of a TRANSAIRE Pressure Transmitter on a distillation column. Note close-coupled connection in field. Receiver may be several bundred feet away.

SOLVED THESE FOUR TOUGH PROBLEMS

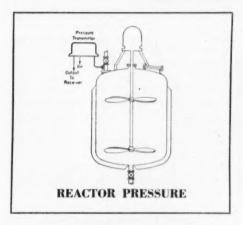


PERMITS MAXIMUM CAPACITY OPERATION

Problem: To operate a column at maximum capacity, consistent with the preventing of flooding.

Solution: As the pressure drop across the column is a measure of the vapor velocity, the measurement of this drop with a short-range, highly sensitive, easily adjustable instrument enables the operator to keep the column safely close to the flooding point.

Result: Maximum production and uniform operation.



FLUSH SURFACE IS CLOG-PROOF

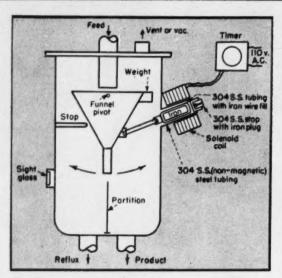
Problem: To measure pressure in reactor kettles containing viscous or corrosive liquids which tend to clog conventional measuring systems.

Solution: The closed volumetric measuring system of the TRANSAIRE Pressure Transmitter presents a flush surface on the inside of the vessel. It is clog-proof, highly sensitive and provides an accurate reading.

Result: Maximum yield of high purity product and a precise knowledge of the pressures maintained.

Taylor Instruments MEAN ACCURACY FIRST

The Plant Notebook Edited by Theodore R. Olive



Corrosion Resistant Diverter Splits Reflux and Product Flows

J. J. KRAUKLIS, Chemical Engineer, The Barrett Div., Research & Development Dept., Philadelphia, Pa.

*April Contest Prize Winner

A highly satisfactory design of corrosion resistant liquid flow splitter for plant or pilot plant use appears in the sketch above. A swinging funnel is positioned by means of a direct linkage to the armature of a solenoid. This arrangement eliminates the need for a stuffing box which is required when linkages are actuated by an external air-operated diaphragm or an external solenoid armature. Use of a stuffing box contributes greatly to leaks. It also means a much greater need for pulling power, which is particularly troublesome when using an external solenoid. An electromagnet made from a coil and iron core is often used where air gap distance can be kept short; but the strength of pulling power falls off rapidly with distance of the magnet from the magnetic element.

The design presented shows a stainless steel liquid

flow splitter for use with distillation column. A swinging funnel splits the flow of liquid between reflux and product connections. The funnel is normally held in the position for reflux flow by a weight on the funnel and by the weight of the armature. Alternately, it is held in position for product flow by the pull of an armature inside of a wire coil. The armature is of Type 304 stainless steel with pieces of iron wire encased.

A stainless steel plug used as a stop at the right of the solenoid also contains iron. An electric on-off timer energizes the coil at proper times to give the desired ratio of time for product and reflux flows.

A sight glass enables the flow of liquid to be seen, and permits action of the funnel to be checked during operations.

Coils of the type used in ordinary solenoid valves are suitable and are easily obtained from stocks of replacement coils for solenoid valves. Coil position with respect to the armature can be varied to reduce vibration and to give the desired strength of pull with reasonable current and heat generation. This helps to extend the life of the coil. An ammeter can be used to measure the current in setting the position of the coil to that giving the lowest current consistent with sufficient pulling power. Current is 1½ to 2 amp. in a coil of 2% in. length and 2% in. outside diameter

The non-magnetic stainless steel tubing on which the coil is mounted slopes towards the main body of the splitter so that the weight of the armature and of the funnel will return the funnel to the reflux posi-

tion when the coil is not energized.

There are several variations of the basic design that are feasible. For example, the linkage to the funnel can be made with the armature in the vertical position, extending through the cover with the coil mounted vertically. The weight of the linkage and armature can be used to bring the funnel back to reflux position. If the coil is used in the horizontal position, a spring can be used to return the funnel to the reflux position. If the splitter vessel is made of a magnetic material, then the metal used for the tube through the coil should, of course, be non-magnetic. However, in this case the entire armature can be of magnetic material.

★ May Contest Prize Winner

"Forcupine Rods Show Temperature Distribution in Dowtherm Furnace."

A prize of \$50 in cash will be awarded to Harlan How, equipment design consult-and, New Bern, N. C. This solution to the problem of leaky furnace tubes will appear in the Plant Notebook for August.

\$50 PRIZE FOR A GOOD IDEA-Until further notice the Editors of Chemical Engineering will award \$50 cash each month to the author of the best short article received that month and accepted for publication in the Plant Notebook. Each month's winner will be announced the second following month and published the third following month.

\$100 ANNUAL PRIZE-At the end of each year the monthly winners will be rejudged to determine the year's best Plant Notebook article, which will then be awarded an additional \$100 prize.

HOW TO ENTER CONTEST-Any reader of Chemical Engineering, other

than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Acceptable but non-winning articles will be published at regular space rates (\$10 minimum).

Articles may deal with plant or produc-tion "kinks," or novel means of presenting useful data, which will interest chemical engineers. Address plant Notebook Editor, Chemical Engineering, 330 West 42nd St., New York 36, N. Y. How Exon 402-A wipes out corrosion

ACIDS ate through every metal tried

...but could not affect

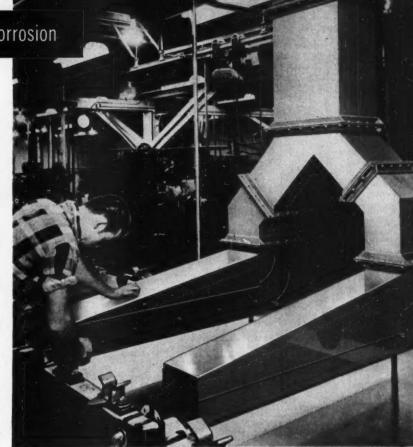
Boltaron 6200

The toughest, most corrosion-resistant metals used failed to hold electro-plating acid fumes at Cannon Electric Company, Los Angeles.

In 2 months, the solution of 33% nitric, 33% sulfuric acid, and 33% fluoride salts destroyed ducts and tanks.

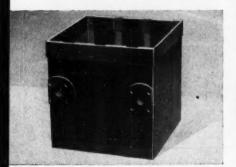
In June, 1953, Plant Engineer Byron Hill installed a completely new ducting system of Boltaron 6200.

It has been in continuous operation ever since. Its present condition is utterly unmarked. Maintenance costs have been wiped out.



Installation by Horace Blackman Co.

Photographs courtesy H. N. Hartwell & Son, Inc., Boston 16, Mass.



★ Eastman Kodak Co., Rochester, reports that Boltaron 6200 remained completely uncorroded by ferricyanide after 3 years, when no other material lasted 3 months.

Installation by Industrial Plastic Fabricators, Inc.



★ A switch to Boltaron 6200 copper-plating rings wiped out corrosion in this equipment at Norris-Thermador Co., Los Angeles. Extremely close tolerances were maintained.

Installation by Horace Blackman Co.



★ For 18 months, sulfuric acid fumes have failed to corrode a Boltaron fume removal system at Electric Storage Battery Company, Fairfield, Conn.





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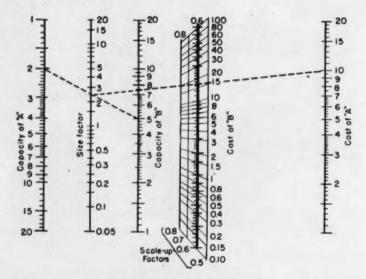
Firestone's Exon 402-A resin meets Boltaron's exacting specifications -best assurance of uniform results under the most corrosive conditions.

These materials can be welded, sawed, sheared, stamped, milled, molded, planed, drilled, embossed, rolled and cemented—on conventional woodworking or metalworking equipment.

For details that will interest you in particular, call or write:

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FIRESTONE PLASTICS COMPANY, Dpt 28-A, POTTSTOWN, PENNSYLVANIA A DIVISION OF THE FIRESTONE TIRE & RUBBER CO.



Six-Tenths Factor Nomograph Shows Costs at Different Capacities

ALFRED B. BABCOCK, JR., Chemical Engineer, Dobbs Ferry, N. Y.

The "six-tenths factor" method for roughly estimating process equipment and plant costs has been a useful rule of thumb to engineers since it was developed by Williams, Chilton and others (ref. Chem. Eng., Dec. 1947, June 1949, Apr. 1950). The nomograph described provides a simple, easy way to use the "sixtenths factor" as well as any other exponential factor from 0.5 to 0.8 which may be applicable to the plant or equipment item being estimated. It can be particularly helpful to management or others who may not be familiar with the method or with the use of the log-log slide rule.

The exponential method for cost estimating is useful for predesign estimates during research and development phases to assist in directing projects along the most profitable lines or for management's use in making quick estimates to determine order-of-magnitude costs for proposed plants or projects.

This nomograph is a graphical representation of the equation $C_A(S_B/S_A)^a = C_B$, where S_A and S_B are the capacities of two plants (or pieces of equipment) A and B, and C_A and C_B are the capital costs of A and B. The exponent x is the "scale-up factor." To use the nomograph:

1. Connect the capacities of the two plants on the scales marked Capacity of "A" and Capacity of "B". This line crosses the Size-Factor scale at a reference point.

 Connect the reference point on the Size-Factor scale with the known cost of A on the scale Cost of "A". This second line will cross the group of lines marked Cost of "B" and Scale-Up Factors.

3. Select the proper Scale-Up Factor line and read the cost of B where the line drawn in Step 2 crosses it.

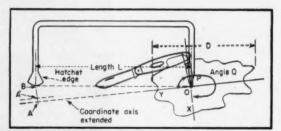
The capacities can be in any logical units as long as both units are the same. The numerical value of the two capacity scales and the two cost scales can be multiplied by the same number (e.g. 10, 100, etc.) without affecting the value of the Size Factor or ratio. The reference point on the Size-Factor scale gives the ratio of capacity of B to A.

The Scale-Up Factors or exponents are the vertical lines with values ranging from 0.5 to 0.8. The 0.6 Factor Line has been made heavier since this factor is generally considered to be an average value.

It is important to note that the scale of costs for B is fan-shaped and that the numbers correspond to the fanned lines. Extensions of

these lines will pass through 1.0 on the Size-Factor scale. Subdivisions for this cost scale are marked on the 0.6 Factor Line. The numerical value of costs and subdivisions of the scale must be determined by following the fanshaped lines to the numbers at the right of the scale. Do not use numbers horizontally opposite the point in question.

In the example shown, Plant A has a capacity of 20 tons per day and costs \$1,000,000. A similar Plant B with a capacity of 50 tons per day will cost \$1,700,000 using a 0.6 factor or \$2,000,000 using an 0.8 factor.



More on Hachet Planimeter

JOHN W. LANGHAAR, Wilmington, Del.

Many engineers who read J. T. Hogan's short article on the hatchet planimeter on pt 226 of the April 1954 Plant Notebook are probably bending and filing steel rods in their home workshops. The hatchet planimeter is accurate and simple enough to merit more widespread use than appears to exist. However, a few additional remarks concerning precautions and accuracy limitations seem to be in order.

A penknife with reasonably tight joints may be used with results almost as reliable as those of the more specialized instrument described by Mr. Hogan. One blade approximately at a right angle to the knife serves as the pointer, and the other blade fully extended behind the knife serves as the "hatchet."

PROCESS EQUIPMENT NEWS

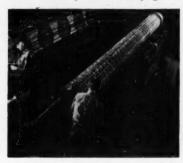
PUBLISHED BY FABRICATED PRODUCTS DIVISION, THE M. W. KELLOGG COMPANY

JUNE-JULY 1954

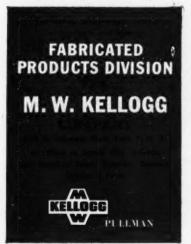
More Fizz for New York's Sodas

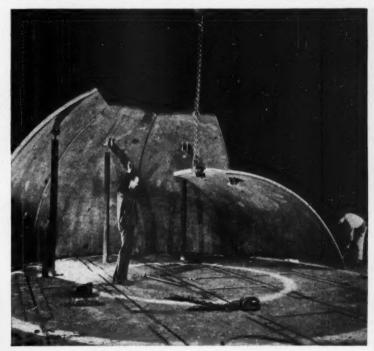
More carbon dioxide—for use this summer in carbonated beverages bottled in the New York area—is the worthy purpose behind this condenser, shown below during the tube loading operation in Kellogg's shops earlier this Spring. During the hot weather season it condenses some 30,000 pounds of carbon dioxide an hour, enough to supply the fizz in something like seven million bottles of soda pop.

On the technical side, one of the more unusual service conditions for the condenser is an extreme pressure differential of over 1300 pounds per square inch. Carbon dioxide on the shell side will be held at a pressure of 1400 psig. Water will circulate in the tubes under a pressure of 80 psig.



The unit will consist of two shells, each with 250 tubes, ¾ inch in outside diameter by 20 feet in length. The two sections are of forged, integral-channel, fixed-tube-sheet construction with admiralty tubes and steel shell cover, channel, and tube sheets.





Mammoth Pressure Vessel for Oil Refinery to Be World's Heaviest

The world's heaviest process vessel, and one of the largest ever built, is now being fabricated in the Kellogg shops at Jersey City. When completed, the vessel—it comprises the reactor and regenerator of a unique Fluid Hydroforming plant—will stand well over 200 feet high and weigh approximately 650 tons.

Knockdown assembly of certain portions as well as complete fabrication of others will be accomplished in the shop before the various sections are shipped to the field for installation.

The illustration above shows the pressed head sections, cut to exact size, being joined together. The four "orange-peel" sections form half of the bottom head of the vessel. After the other half of the head is fabricated in the same manner, the two halves will be fitted up and match-marked in the shop, then shipped to the job site

for final assembly.

The reactor vessel, which will be approximately 135 feet high and have an internal diameter of 23½

feet, will be topped by a smaller vessel, 12½ feet in diameter and 74 feet high, in which catalyst for the reforming process will be regenerated. Over all height of the completed unit, exclusive of the supporting pedestal, will thus exceed 200 feet.

Like the bottom head, the top head and the nine courses for the shell of the large reactor will be shipped to the job site in longitudinal halves. The smaller regenerator vessel will be fabricated in the shop, stress relieved in one of Kellogg's huge furnaces, and shipped to the job site fully assembled. Stress relieving of the welds in the reactor, in itself a job of tremendous magnitude, will be done in the field after the vessel is erected.

The reactor is being fabricated of carbon-moly steel plate, varying in thickness from 2 inches for the top head to 234 inches for the lower shell courses and bottom head. Chrome-moly steel plate will be used for the regenerator section.



EXCHANGERS



THIN WALL



CLAD STEEL VESSELS



CONDENSERS



FRACTIONATING TOWERS



PRESSURE



DIGESTORS



COOLERS

Accuracy of tracking may be tested by running back and forth on a straight line to see if the hatchet edge stays on the line. Small deviations are unimportant, and may ordinarily be compensated for by averaging two readings: (1) Tracing first down (along OX in Mr. Hogan's diagram), clockwise around the curve, and back to the center; and (2) starting over again and tracing up (in the reverse direction from OX.) counterclockwise around the curve, and back to the center. This procedure also helps to compensate for the small error due to the estimated center not being the true

For figures of several square inches or more, results accurate to within 2 or 3 percent may be expected with careful manipulation and measurement, if the planimeter length L exceeds 1.5 times the largest diameter D of the figure. With L/D as small as 1.0, the theoretical error may be as high as 4 to 5 percent, depending on the shape of the figure. The theoretical accuracy rapidly improves for larger L/D, but accurate measurement of the displacement AB of the hatchet becomes more difficult so that L/D less than 5 is

usually desirable.

As already indicated, the instrument is not exact even in theory, but generally gives results slightly high. The magnitude of the error depends not only on the shape of the figure, but on the direction of the "radius" along which the pointer is moved and on the direction of tracing around the curve. Referring to Mr. Hogan's diagram, assume that the radius OX is at an angle O clockwise from OY, and the curve is traced clockwise. Then in the diagram, Q = 270 deg. For this and other angles, the estimated area for a circle of diameter D would be larger than the actual area by the amount shown in the following table, where L times the chord AB is the estimated area:

	- Verne	Frenc Percent	When $Q = \text{Deg.}$		
L/D	0	90	180	270	
1	+8	+6	0	+2	
2	+2	+2	+1	+1	

Use of the arc instead of the chord AB would increase these errors; hence the chord is recommended for both

simplicity and accuracy.

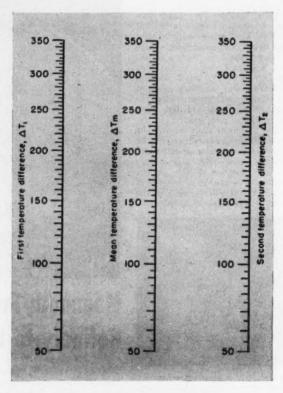
An additional error arises from not having the starting point O at the center of the figure. In a rather extreme case with the estimated center 5 percent of the way from the true center to the perimeter, the error from this source can be 2 to 3 percent for L/D of 1.0, or 1 to 2 percent for L/D of 2.0, when using

Inner Tube Mystery De-mystified!

If you have followed the discussion about the linearity (or lack of it) in the inner-tube scale which won the \$100 Annual Plant Notebook Prize for D. H. Geiskieng, look for the symposium of explanations next month. A surprising number of engineers have come up with answers to this puzzler.

the average of two readings as suggested above. The center location for figures normally encountered in engineering work can ordinarily be estimated more accurately than this.

Unusual figures, as for example an outline of the Great Lakes, should be divided into a suitable number



Log Mean Temperature Difference Found by High Speed Chart

GREGORY THEOCLITUS, Wellsville, N. Y.

Above is an empirical nomograph which simplifies solving the log mean temperature difference equation, $\Delta T_m = (\Delta T_1 - \Delta T_2)/(\ln \Delta T_1/\Delta T_2)$. It is especially useful in cases where it is desired to work backwards from the log mean temperature difference and one of the delta T's to find the other delta T, since in this case the equation itself can only be solved graphically or by trial-and-error means.

As an example of the nomograph's use, assume ΔT_1 = 300 deg. and ΔT_9 = 140 deg. A straight line connecting these points on their respective scales will intersect the ΔT_m scale at 210 deg.

Likewise, if ΔT_m is assumed to be 210 deg. and ΔT_1 = 300 deg., a straight line connecting these points on their respective scales, if extended, will intersect the $\Delta T_{\rm e}$ scale at 140 deg.

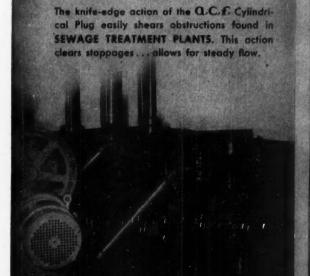
The nomograph can be used with either Fahrenheit

or Centigrade degrees.

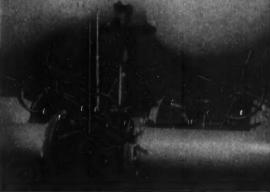


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more engineering-minded production men read it ... more

THIS PAPER?" ROARED THE PUBLISHER

Nineteen editors cringed, the ad director stumbled into his waste basket, a dozen business department staffers salaamed. "You are, sir," they quavered.

"Well, let's knock off those reader opinion surveys," growled the bossman. "A thousand letters a month cost dough. And cut out that Reader Service stuff too. If those guys can't write to the manufacturers themselves, why should we do it for 'em?"

"Yes sir, but...," broached the Editor. "Don't but me!" snorted the Master. "If you'd stop gallivanting around those plants listening to engineers' problems, our overhead wouldn't be so high. Isn't that where you picked up that high-priced new layout idea to cut down ads and editorials running on the same page?"

"You bet it is, Mr. Publisher!" piped up a voice from the water cooler. "That's where any good editor goes for his best ideas. Where else would he get 'em but from the readers themselves?"

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How Does Your Writing Measure Up...

... at These Nine Vital Points?

J. R. GOULD with commentary by N. G. SHIDLE

Note—If you're like most chemical engineers, you've probably noticed that a big chunk of your time is spent in writing. And, again, if you go along with the majority, you probably don't enjoy it.

Well, if such is your predicament, this article is your meat.

Our author, Jay R. Gould, is the director of the Technical Writers' Institute of Rensselaer Polytechnic Institute and a well-known teacher of technical writing. His nine check points can mark the route to better writing for you. Norman G. Shidle, whom we've asked to do the commentary, is editor of the SAE Journal and the author of "Clear Writing for Easy Reading." His somewhat different viewpoint will aid you—especially when you write for publication.—Editor.

Can you . . .

- √ Force your writing to serve you?
- √ Make your personality pay off?
- √ Keep your story on the beam?
- √ Gage your material requirements?
- √ Get off on the right foot?
- √ Buttress your text with the right example?
- √ Keep the reader moving with you?
- √ Brake to a stop at the right place?
- √ Guarantee pleasant, profitable reading?

ONE EVENING not long ago, I sat in the Engineers' Club in New York with a prominent young engineer, the vice-president of a large construction company. During our conversation he brought up the subject of the writing problems that confront the engineer.

"Every engineer has to write at some time or another," he said. "Of course, all of us in our college days had visions of passing the writing job over to our secretary, or even the office boy, but in reality it has turned out differently.

"Today the engineer is responsible for all kinds of communication jobs. Reports have to be turned in to government agencies, inter-company memoranda have to be written, and articles must be prepared for trade journals. Also, if the engineer wants to get ahead, he may find it necessary to deliver papers before professional societies. Yet we often find ourselves unprepared to do the writing job."

That engineers can't write is a myth that engineers themselves have nurtured, just as my friend at the Engineers' Club was doing. He's a victim of self-delusion.

NEXT MONTH . . .

Top job of a leader is getting and keeping the loyalty of his subordinates. If you now direct the work of others, or if you aspire to such a post, tips on how to mold—and hold—that loyalty can help you do a better job. Look for them in next month's YOU AND YOUR JOB.

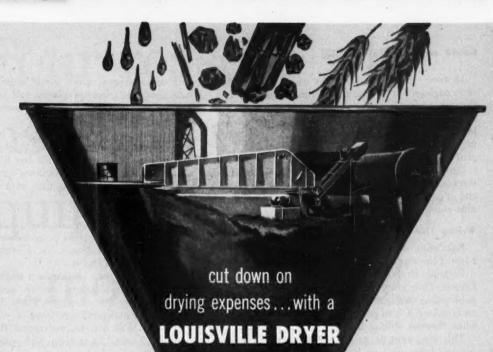
This delusion is that writing is an art; that very few people can write; that it's hard work (1) and that it better be left in the hands of other people.

It Can Be a Science

Writing can be an art, but it can also be a science. And it is nonsense to say that very few people can write. Very few can write well enough to win the Pulitzer Prize, but most people, if they took the pains, (2) could write adequately and effectively.

It is hard work. That's why so many people do it badly. And the hardest part of the work is the clear thinking which must precede.—NGS

⁽²⁾ Right again. But the pains must give birth to well-organized thoughts. Just suffering isn't enough.—NGS



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More than once, a Louisville Dryer has turned a losing operation into a profitable one. Write or call for a Louisville engineer to make an obligation-free survey of your operation. However, my friend was right when he said that every engineer has to write at sometime or another. It is the vast increase in writing assignments that has thrown many engineers into a tailspin. Since the war, it has been estimated that the volume of written work streaming from the average company has increased four hundred fold.

Can something be done to offer the engineer certain short-cuts to lick his writing problem? I think it can, and it's on this assumption that I am offering these nine check points for writing.

Writing That Has to Be Done

But before we arrive at our checklist, let us look at a few of the writing situations that involve the engineer.

Certainly he dictates letters, if he doesn't write them himself. Only a few weeks ago I had a letter from the publications manager of a utility company commenting on how hard it is to get people to be simple and direct when they are writing business letters.

This man went on to say, "When a man writes a personal letter, his tone is usually light, he sounds as if he enjoyed writing the letter, and what he says sounds like good normal conversation." But the minute he begins a business letter, oh boy, bring on the jargon!"

But to go on with our list: The engineer may have a hand in preparing manuals of one kind or another; he may have to write promotional copy. And all the time, if he's an asset to his company, he is forever explaining that company and its activities to the general public through what he says and what he writes.

Analyzing the Problem

So because your writing assignments are so varied, I submit this as Check Point 1 in your short-cut to writing. Size up the situation. Analyze the writing problem in at least three ways.

The first of these is to find the purpose behind the writing—why you are setting it down on paper.

Are you briefing someone in your company on a new development connected with your product? Perhaps all your reader requires, then, is a plain answer to a plain question. Cut out the frills. Make it simple and terse. Imagine that every sentence you write is costing money. Get the information down and stop worrying about how it sounds.

But perhaps your reader wants more than plain information. He's not completely sold on your proposal. In that case, you have to be more persuasive. Deliberately select your vocabulary.

The writers of adjustment letters are told never to use the word complaint in writing to dissatisfied customers. That word is guaranteed to lose friends. There are many, many such words in business communication, some that are pleasant, some that leave a bad taste. Watch your words.

Who's Reading It

But besides considering the purpose behind our writing, we must pay attention, a lot of attention, to the man who is going to read it.

In some writing jobs he may be a single reader, the president of your company, another person in your office. And if he is someone you know, I'm sure that you keep a mental picture in front of you while you are writing. Will Mr. D. understand this, you say. Or, Fred is a crank on grammar and punctuation. I'd better check and recheck.

But do you use the same care when your readers are more complex, the members of a professional society or the stockholders in your company? You should. Every reader, whether an individual or a composite, has his peculiarities.

The Situation Sets the Style

The third division under our first check point is this. What kind of material are you using and to what extent will it condition your writing? Engineering material by its very nature often calls for a certain style. But this doesn't mean it has to be "jargon." It doesn't necessarily have to contain a statement such as this from a government agency: "This office maintains a chronological suspense upon matters to which a response is expected."

Material prepared by technical writers for technical readers, usually need not contain as much illustrative material as material written for nontechnical readers. And on the other hand, some material cannot be "popularized" no matter how much you try. What you gain in interest value you lose in accuracy.

So check Point 1. Analyze the writing job in its three aspects of what you want to accomplish, the kind

Shidle comments . . .

3 It's good to have our writing sound like normal conversation; but fatal for it to be like normal conversation. Conversation and writing are two different forms of communication; require different techniques. Conversation is received through the ear. The speaker sets the pace. Repetitions and

emphasis necessary and possible in conversation are loose and wordy when copied in writing. Get stenotype notes of any high-grade conversation you've been in, if you doubt this

4 Define the purpose as well as find it. Force yourself to write down in one sentence the main point you want to convey. Do this before you start to write. Then what you write becomes simply an amplification, explanation, or proof of that main idea.

It's the easiest way to insure good organization adapted to the special purpose of the particular piece of writing.

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of reader you have, and the special conditions that the material itself demands.

Where YOU Come In

At this point a statement by a colleague of mine at Rensselaer comes to mind. Of engineering writing, Prof. Douglas Washburn has this to say: "Certainly a degree of objectivity is necessary, but frequently technical writing seems to strain so far in this direction that it gives the impression of having been written by a machine rather than a human being."

Let your personality show through your writing.

This will be Check Point 2. Show that the writing has been done by a man, not a machine. 5

What would you say if you were invited by your employer to talk over a deal with him, only to find that you were to be on one side of a screen, and he on the other? The channel of communication would be poor to say the least. Yet this analogy, ridiculous as it is, is minor compared to what often happens to the engineer when he sits down to write. He sets up his own screen.

He has been conditioned to such an extent by something called "technical style" that his native way of saying things has been throttled, and, as Prof. Washburn remarked, he has become a machine.

How to Stick to the Subject

It has been said that the idea back of every good piece of writing can be expressed in a single sentence. 6 Teachers of writing call it the thesis sentence.

Check Point 3: Decide what the subject of your piece is going to be—then stick to it. 7 Every writer as he is working, just as I am doing now, thinks up ideas, with incidents to enliven his writing. Sometimes they belong; more often they don't.

So stick to your topic even if it means pitching a pet idea into the waste-basket. One way to achieve this singleness of purpose is to draw a box on a piece of paper, and in it write your thesis sentence. 8 And from time to time, especially as you pass from one point to another, glance at the box and see if your new material will go into the box. If it won't, discard it. Be particularly ruthless in revision.

How Much Material Do You Need?

Check Point 4 is for you to assemble all the material that you possibly can, and if some of it seems beyond your needs at the time don't worry. Material for your piece of writing will come from many sources: research, things you've seen, experiences you've had. Especially don't overlook that last source. Your experiences are part and parcel of your ideas.

So gather as much material as you can. Nothing gives you a happier feeling than to know that you have reserves to draw upon. It will prevent a thin piece of writing.

How to Get Going

Many writers feel that they must start with something called an introduction. My personal reaction is this. If you think you need a warm-up period, by all means write an introduction. But later on, when you are revising, see if you can't cut it off. 9

Check Point 5, then, is to take particular care with your beginnings. Elizabeth Ogg, a professional author specializing in interpreting technical material to the layman, says this: "Beginnings are strategic. They may make a difference in whether your writings get read or passed by."

The initial paragraph of your writing, then, not only presents the material to the reader; it induces him to

read it in the first place. 10

The beginning, however, must be compatible with the rest of the piece and with the reader. A controversial statement, a quotation, something lifted from today's newspaper, all these will dangle the bait in front of the reader. 11 But each in its own place. A report on an important process for a man who must use the process will demand little in the way of a fresh beginning. But your colleagues may be more wily. Their reaction may be: "Oh, are we going to hear that again?"

An article before me, written by an engineer for engineers and about a Canadian steel man starts out this way: "When Adam Smith was a boy, he wanted more than anything else to grow up to be a mechanic." A name strikes our attention, a story is being told.

A bulletin on photography, aimed at serious photographers, begins less visually, but it has a positive

Shidle comments . . .

Very desirable . . . but a touch dangerous for the unskilled amateur. Trying to put "personality" into his writing, he often ends up merely verbose and trite. Too often he turns cliches. Might be safer if this were moved back to Number 9 instead of being Number 2.

6 In my opinion, this is by far the most important point of all.

The man who actually does this before writing has a hard time doing a really bad piece of writing—if he sticks to his thesis.

7 Amen!

8 Amen again. And why not work this into your lead sentence? Everything else will flow naturally and effectively from it.

9 Cut it off! Don't just "see if you can't cut it off." Do it.

10 And here is the reason for cutting off the introductory "warm-up".

11 Be Careful! Like the advice to put in "personality," this sort of "human interest" lead can come out badly more often than well for the everyday writer. I believe that the writer's job is to interest the reader in his thesis—and the sooner he starts doing it the better.



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approach and a deliberate goal in mind. It says, "The aim of most photographic effort is to make a print of satisfactory quality." Not sensational, but useful to the purpose and the reader.

Don't Forget to Show 'Em

Check Point 6: Less interpretation and more illustration. 12

A writing assignment of any length can be broken up into a number of segments or main points. But if you want your main points to do more than go in one ear and out the other, you must illustrate each of them.

There is a difference between illustration and interpretation. When a writer says in other words, you can be sure that he is going to interpret for you; unfortunately, the interpretation is sometimes more cloudy, more confusing than the first thing he said.

Get into the habit of providing a pungent example for each main point. Give the reader something to visualize, a good concrete down-to-carth example. Draw on your personal experiences. Every reader likes to read stories. Take him on that job you did. Let him see you in action. Keep a file of items which you think might be useful—then use them in your writing.

How to Hang On to the Reader

Not only must we provide examples for our main points, we must provide the means for the reader to get from one main point to another. Not being as familiar with the content as you are, he often loses his way. He says, "A moment ago you were talking about Korea. Now we seem to be in ancient Rome. How did we get here?"

Check Point 7: Give the reader signs and guides to show him the direction of your thoughts. Our language is lavish with such transitional devices: such phrases as nevertheless, although, consequently, however, in addition to.

When the reader sees these, he knows that you are shifting your direction, and he is being told to be on the alert. There are hundreds of such directional words. Sprinkle them liberally throughout your writing. 13

How to Put On the Brakes

The next Check Point, 8, pertains to the ending. While the beginning attracts attention, the ending of your piece should leave the reader with the feeling that he has accomplished something by having read it. 14 This feeling can be arrived at in a number of ways.

First of all, it is a good idea to make some demands on the reader, to ask him to do something. Don't let your writing "run down." And a way to avoid this is to give it a lift instead of sending it into a decline. Put some pressure on the reader. If nothing else, ask him to think about the ideas you have presented.

Or provide him with a summary of the main issues. Especially if the piece is of some length, this device is good not only for the reader, but also for the writer. It forces him to be logical in arrangement.

A third principle connected with the ending is always to save something for the ending. Make the circle complete. If you began with a story, end with a story. Take a tip from the skillful public speaker. Observe how he finishes with an anecdote or a punchline; when he doesn't have any more to say he stops cold.

Is It Readable?

And now before we come to an ending for this article, consider for a moment Check Point 9, the over-all principle of readability. Here I would like fo cite the case of John Newsome, a third-year student in a special writing course I conduct.

John, a fledgling engineer, would like to have a side career as a writer of science fiction.

He reacted strongly when I criticized his first effort. It was full of purple passages and roundabout ways of saying things. John couldn't say, "The man went on reading the book." Instead he said, "His lips continued to read." And one very mixed metaphor bore the sentence "His body bore my scars on its handsome face."

His writing was unnatural as well as inaccurate.

Until the John Newsomes come to their senses, not much can be done about their writing. John somehow had the idea that when you turned to fiction you aban-

Shidle comments . .

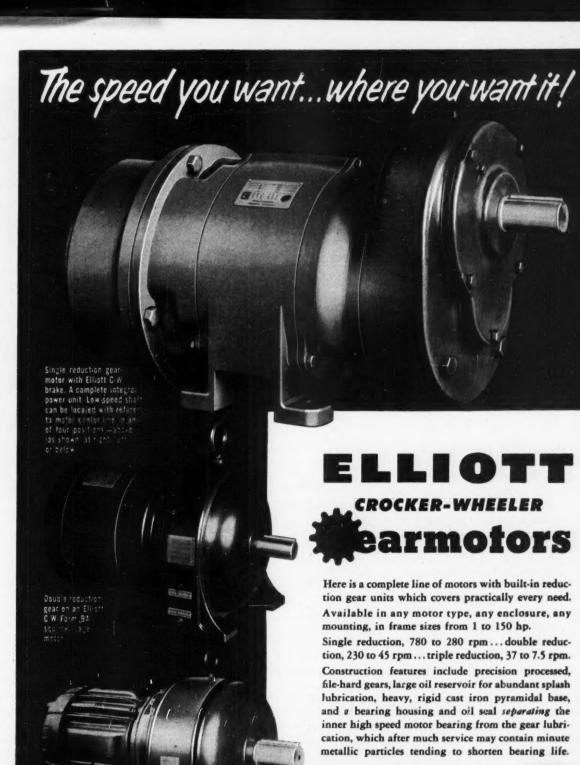
12 Very important—and infrequently done. Examples are much harder to dig up and express than generalities and opinions.

13 This is good advice. Used for exactly this purpose, the suggested words are excellent. . . . Trouble is the average everyday writer tends to toss in such words too frequently when they aren't needed. . . . Usually they are "empty" or "say-nothing" words. I'd suggest adding the advice: "When in doubt, leave them out."

14 Here's the only point on which the professor and the editor really differ. To me, the ending is of very minor importance as compared with the beginning. Reader surveys prove that scores will read the first paragraph of an article or report for one who gets to the finish. Most engineering writing that crosses my desk is most easily improved by putting its last paragraph first. Either article or report is most interesting when the conclusions come first and the article

or report proves them.... Besides, the main points will thus have been registered with a maximum—not a minimum—number of readers.

(For eight years now, at least one engineering society publication has been applying exactly this technique to the rewriting of all papers. Only thanks and congratulations for the technique have come from readers; scarcely a single kick. And less than one half of one percent of some 1,600 authors have objected.)



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doned normal ways of saying things and indulged in something called "pretty writing".

I'm afraid that something of the same sort prevails among engineer-writers—only in reverse; that when you write up technical material, you abandon good easy communicative writing and adopt something called "literary" style.

How to Boost Reading Ease

One piece seems easier to read because the writer has used comparatively short paragraphs and sentences. He has made direct statements, not cluttered them with modifications and amendments. The page looks easy because he has left plenty of white space.

If he has written a report or a research article, he has used crisp informative headings. He has used a vocabulary that has good visual words in it, words you can see, and feel, and hear. He has used names, names of people and places. The reader's eye is caught by the name of a famous scientist; he recognizes a product by its trade name.

In any analysis of writing, many more factors enter. A complete mastery of them belongs to the really professional writer. But most of us look upon writing as an extension of other work, as a vehicle for expressing what we do.

Where to Check Yourself

In any writing assignment, then, after you have completed your first draft, check it at these nine vital points. They are: 1. analyze the situation and see if you are doing what you had intended; 2. allow your own personality to show through your writing; 3. stick to the topic under discussion; 4. consider your material, and make sure that you have more than enough; 5. pay particular attention to the beginning; 6. check the main points for pertinent and interesting examples; 7. give the reader plenty of transitional devices; 8. provide a sharp and decisive ending; and 9. make the piece of writing as readable as possible.

Check these nine points in your writing, and help destroy the myth that engineers can't write.

PROBLEM DRINKERS

. . . Can You Spot Them?

If your company runs close to the national average, a fair number of your fellow-employees are alcoholics. That's the verdict of authorities on the subject.

Of course, the actual number will vary with the age, sex and national background of your co-workers, but on a nationwide basis, these savants estimate that some 6 percent of the males who drink are alcoholics. Many others, they say, are in the hard-to-recognize "pre-alcoholic" stage.

How can you spot an alcoholic in industry?

Well, it's not easy. And to make matters worse, his fellow-workers and his supervisors will often cover up for him. However, there is a set of symptoms which can provide an indication, a clue. These include:

 Consistant tardiness or absence on Monday mornings and frequent instances of leaving early on Fridays.

 Unexplained disappearances from the job.

 Recurring absences excused as minor illness, such as a cold, bronchitis, upset stomach; or too frequent off-duty accidents, particularly with assault as a factor.

Personality changes in a previously good worker—arguments, criticism of others, recurring mistakes for which he defends himself, minor accidents which he blames on others or on equipment, marked variation in mood or a general disinterest in work.

Remember, alcoholism is a disease. Spotting it is the first step toward curing it.—Industrial Relations News

FOLLOWERSHIP

. . . Clue to Leadership

The type of leader a fellow likes to follow has a great bearing on the kind of leader he'll make. This "followership", or preference for a particular brand of leadership, is just beginning to be recognized and studied.

Tests have shown that the average guy prefers that form of leadership (be it autocratic, democratic or the "free-rein" type) under which he will function most happily and productively. Certainly not a very startling conclusion. Further testing and comparing, however, indicates that if you know the followership tendency of an individual, you can predict the leadership method he's most likely to use.

This could be a valuable tool for selecting leaders, for resolving personality clashes and for increasing your own effectiveness as a leader.

How do engineers rate on followership?

Engineers, results indicate, tend to show an unusually strong preference for the "free-rein" type of leadership. In other words, you'll probably get better work from them if you exert a minimum of control. Give them materials, information and so on; and then turn them loose on a problem—resisting any impulse to butt in. Working "on their own" they'll probably do a better job.—FACTORY Management and Maintenance

WEAKNESSES

. . . In Engineers' Writing

Some interesting information on the weaknesses in the writing of engineers came to light in a recently-ended course in technical writing given at the U. S. Naval

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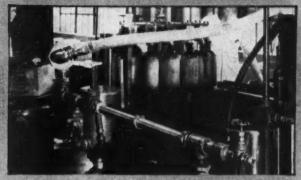
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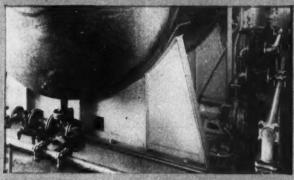
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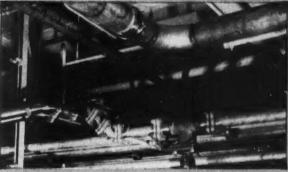
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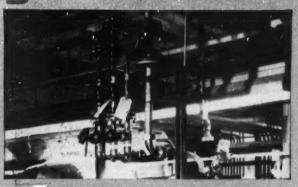
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Tri-Clover stainless steel conicel and fittings are used here in processing Pyrogen-free distilled



View shows Tri-Clever conical end, sunitary, industrial welding and Tri-Clamp fittings utilized in several different liquid transfer lines.



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Engineering Experiment Station, Annapolis, Md.

Top stumbling block appears to be the complex sentence. Because clauses and phrases are tossed around with little regard to proper relationships, "cart before the horse" situations are all too common.

Stilted English is another major fault. Many engineers insist on obscure and formalistic phrasing—no matter how hard it is to read and understand. For example, many in the course saw nothing wrong with the phrase notwithstanding the fact that—until it was pointed out that the single word although is simpler to write, easier to comprehend.

Others were unable to improve on the roundabout construction in the sentence: "The acid technique is not one which can be used by inexperienced personnel." Only a handful substituted a simple and direct cannot for is not one which can.

BRIEFING COURSES

. . . To Up-Date Knowledge

A place where progressive practicing engineers can go for a "briefing" on the many engineering advances made since they left school has recently been announced by the College of Engineering of the University of Texas.

Its newly-established Institute of Advanced Engineering is now offering courses in the various engineering specialities. These courses are designed to bring the engineer upto-date on the mathematical and scientific theory behind the newer developments in his field as well as to point out their applications and implications.

First courses at the institute began this summer.* Each course lasts three weeks, classes being held five days per week. All classes, including the laboratory work, are held at the university's main campus in Austin, Tex.

While the three lead-off courses are not of major interest to the chemical engineer, the institute has announced plans to offer courses in all branches of engineering in the future.

FOR BETTER MEETINGS

. . . take a cue from TV

How often has it been your "privilege" to sit in at a technical meeting and hear speaker after speaker drone on about some highly technical subject, never once lifting his eyes from the paper—not even to count the number in the audience who were asleep.

Well, whether today's speaker likes it or not, when he is up before a group of people he is in the "visual presentation" business—just as surely as any television program. So why not adapt the techniques of TV to the lecture platform?

This was the question that a group of people at the Nash-Kelvinator Corp. asked themselves when they were requested to work up a presentation of the activities of their department for a discussion with other plant members.

The results: The March, 1954, issue of Purchasing reports that, "The program featured a panel of eight members of the department, who told the rather complex story of their operations concisely, smoothly and interestingly, without once referring to notes or manuscripts and without missing a single point. It had all the pleasant informality of a casual discussion, and all the 'meat' and logical sequence of a carefully planned and rehearsed presentation."

The secret of this "best meeting in years"—use of the teleprompter, TV's gift to gab.

None of the speakers appeared to be reading his pieces. They looked about, related anecdotes and talked "off the cuff" without losing their continuity or forgetting any detail of their presentation. This was made easy with four teleprompters hidden behind the platform skirt and with a skilled operator in the wings.

The whole text of the program, with appropriate cues for slides and charts, was constantly before them. This set-up gave the speakers a degree of mobility otherwise unattainable, and added life and interest to the program.

As the department head said later, "The teleprompters were worth many times the rental which we paid for them. Time is worth money, and using these teleprompters saved us a great deal of time, while enabling us to make a more interesting and effective presentation than we could have made without them."

Closer to home, a recent session of the Institute of Radio Engineers made the teleprompter available to all speakers at its annual convention. Even complicated mathematical expressions were handled by the device. Speaker and audience reactions ran the gamut from favorable to very enthusiastic.

Maybe your next meeting could be spruced up with one of these speechmaking aids.*

READING

. . . On Company Time

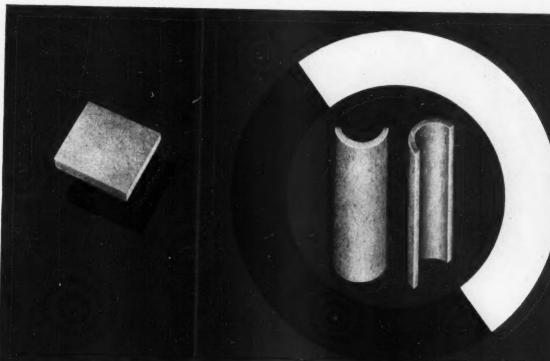
Electronic Engineering Co. of Calif. had a problem. Its technical and management people were doing too much reading on the company's time.

Sure, it was a fine thing that the men were on their toes and keeping up-to-date on the news and doings of the industry, but they were just spending too much time at it. Such reading is too valuable to stop, but the time called "working hours" is valuable too.

The solution: The company drew up a list of selected business papers and trade publications. Employees were told to subscribe to those desired and the company would pay two-thirds of the subscription price—provided the publications were sent to the employee's home.—Business Week

^{*}June 14 through July 2, Advanced Experimental Stress Analysis; Aug. 16 through Sept. 3, New Development in Communication Theory; Aug. 26 through Sept. 15, Composition and Properties of Oil Well Drilling Fluids.

[°] If so, the people to see are the folks at the TelePrompTer Corn. Head-quarters at 270 Park Ave., N. Y. C. This firm also has representatives in Los Angeles, Chicago, Cincinnati, Pittsburgh, Philadelphia and Washington, D. C.

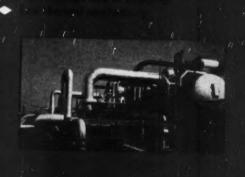


UNIBESTOS



write for

UNARCO





Once upon a time a Milwaukee spice processor got fed up with replacing \$18.00 screens ruined by tramp iron hurled through them by a spice mill.

So he called his Dings Magnets representative, who advised him to put a Dings Perma-Plate Magnet at the base of the hopper that fed the mill.

This powerful, non-electric Alnico magnet traps and holds tramp iron in its field until the mill is cleaned at the end of an operating cycle.

This is the way Dings Magnets can help processors of all kinds to protect equipment, produce a more pure product. Write for free Catalog C-5000-B.





DINGS MAGNETIC SEPARATOR CO. 4730 W. Electric Ave. • Milwaukee 46, Wisconsin



It's a powerful, non-electric Dings Perma-Plate. Perma-Plates are available in a complete range of sizes and three strengths. They're assily installed in chutes, ducts, over belts and elsewhere. They require no maintenance, have certified strength that's guaranteed

Magnetic Separation Leader for over Fifty Years

EVEN WATER under certain conditions can impose a severe burden on pumping equipment Add variables of viscosities, specific gravities and solids to difficult system head and capacity conditions and the pump problem can often only be resolved

THE COMPLETE

ALL SOLUTIONS ARE chemical solutions:

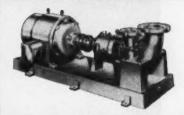
Peerless HORIZONTAL PUMPS...



FOR CHEMICAL TRANSFER SERVICE TYPE CTB
—A #20 alley pump with mechanical shaft
seal design.
Described in Bulletin B-1606.



FOR CHEMICAL PROCESS WORK TYPE DS— A truly all purpose pump for higher heads and capacities. Described in Bulletin 8–1600.

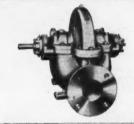


FOR HEAVY DUTY PROCESSING TYPE PR—Rugged conter-line-mount design for hydrocarbons and process liquids.

Described in Bulletin 8-1605.



ECONOMICAL ALL-PURPOSE PUMPS TYPES PE and PB—Water handling pumps, available in widest range of sizes and hp. Described in Bulletin B-2300.

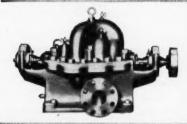


PACKINGLESS WATER PUMP TYPE AS—A mechanically shaft sealed, split case, general purpose pump.

Described in Bullistin 8-1350.



SPLIT CASE HORIZONTAL PUMPS TYPE A— Quality, performance and efficiency are paramount in this line. Described in Bulletin 8-1300,



2, 3, 4 and 5—STAGE PUMPS TYPE TU—Multistage split case pumps for medium capacities at high heads.

Described in Bulletin B-1400.



MAGNETIC DRIVE PUMP—Liquid is confined to wetted end. Lookage eliminated. Revolutionary design. No packing; no seals. Described in Bulletin B-1607.



HOT OR COLD VOLATILE LIQUIDS TYPES TVE and TVB—Turbine vane type pumps for clear or vaporous liquids. Described in Bulletin B-2205.

INDIVIDUAL
BULLETINS AVAILABLE
COMPLETELY DESCRIBE
AND ILLUSTRATE EACH
PUMP LINE.
Write for your copies
by Bulletin Numbers.



PEERLESS PUMP DIVISION

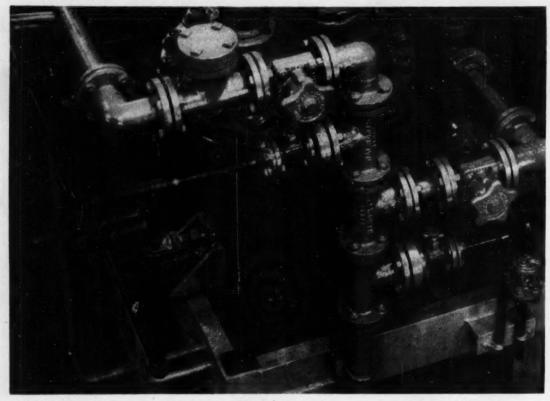
FOOD MACHINERY AND CHEMICAL CORPORATION



Factories: Los Angeles, Calif. and Indianapolis, Indiana.
Offices: New York; Atlanta; Chicago; St. Louis; Indianapolis;
Phoenix; Fresno; Los Angeles; Dallas; Plainview;
and Lubbock, Texas; Albuquerque, New Mexico.

Distributors in Principal Cities; Consult your Telephone Directory.

The Corrosion Forum Edited by Morgan M. Hoover



PROMINENT in this arrangement of chemical processing equipment are saran pipe and fittings (black piping).

Preventing Corrosion With Saran

This thermoplastic material lends itself to many applications in chemical processing. It has excellent resistance to most acids and organic solvents.

The name saran represents a series of vinylidene chloride polymers and copolymers with vinyl chloride or acrylonitrile. The material is highly crystalline, the amount of crystallinity varying with the amount and kind of copolymer material used. Of these polymers, vinyl chloride-vinylidene chloride copolymer is the best known. The information contained in this article applies to this material in its most common form.

Saran's chemical resistance

prompted the development of saran tubing, saran pipe and saran lined steel pipe. All of these products are finding increasing acceptance by the design engineer in corrosion control.

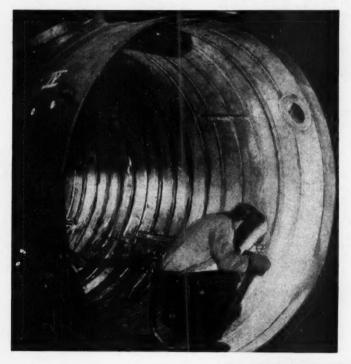
Saran rubber, based on one of the copolymers, is available in sheet form for tank linings and can be molded and cured much like other rubbers. The physical properties and chemical resistance charts in this article do not apply to saran rubber. However, saran rubber is also characterized by its inertness to many chemicals.

Available Forms

Saran is available as a molding powder for use in fabricating molded or extruded shapes, sheets and filaments. Special techniques have been developed in the compression, transfer and injection molding of saran.

Also available are such finished products as saran tubing, available in sizes ½ to ½ in. inclusive, unsupported saran pipe and fittings in standard iron pipe sizes ½ to 6 in. inclusive, and saran lined steel pipe, valves and fittings in standard iron pipe sizes 1 to 6 in. inclusive. Due to the saran lining, the inside diam-

Made to Last in Severe Corrosives



A TOWER OF RESISTANCE

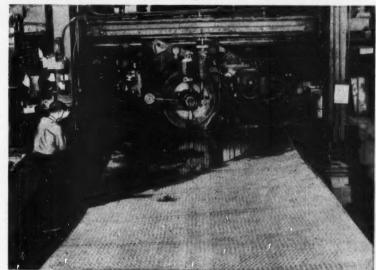
Strips of HASTELLOY alloy C are being are-welded to this 41-ft, long tower to give it added corrosion resistance. The entire inside surface of the vessel is covered with ½-in, thick sheet.

SEALING OUT CORROSION

This lining of HASTELLOY alloy F will resist acids and alkalies. It is attached to steel by the Smithlining* spotweld process, one of the many ways of attaching HASTELLOY alloys to steel. Use of lined-sheet is an economical means of handling severe corrosives.

Hastelloy alloys can help solve your corrosion problems, too. For further information, contact the nearest Haynes Stellite Company office.

*"Smithlining" distinguishes an exclusive process of the A. O. Smith Corporation, Milwaukee, Wisconsin.



HASTELLOY alloys

Nickel-base, corrosion-resistant alloys available as sheet, plate, bar stock, welding rod, welded tubing and pipe, cast pipe and pipe fittings, sand and precision-investment castings.

"Hastelloy" is a registered trade-mark of Union Carbide and Carbon Corporation.

Haynes Stellite Company

A Division of Union Carbide and Carbon Corporation

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Physical Properties of Vinyl Chloride-Vinylidene Chloride Copolymer*

Property	Unit	Average Test Result	Method
Mechanical Properation			
Tensile strength. Upper yield. Ultimate.	Lb./in.*	2,700-3,700 3,000-5,000	D638-49T
At yield	%	15-24	D638-49T
At ultimate Compressive properties Yield strength, 0.2% offset	Lb./in. ¹	2,000-2,700	D695-49T
Strength at 20% deformation	Lb./in.9	4,500-6,100 4,300-6,100	D790-49T
In tension. In compression In flexure Hardness, Rockwell Imnact strength	×10* lb./in.*	0.55-0.8 0.55-0.95 0.55-0.95 M50-65	D638-49T D695-49T D790-49T D785-48T
Isod notched	Ft. lb./in. of notch	0.3-1.0	D256-47T
Thermal Properties Flammability Flow temperature Heat distortion Specific heat Thermal conductivity	In./min. °F. °F., 264 psi. Cal./°C./g. Cal./sec./em.*/ °C./em.	Self-extinguishing 240-280 130-150 0.32 3.0×10 ⁻⁴	D635-44 D569-48 D648-45T
Thermal coefficient of expansion	In./in./°C.	19×10-4	D696-44
Electrical Properties Dielectric strength, short time, ½"	Volts/mil Ohms/cm.	350	D149-44
Dieleatric constant	4.5-6.0 3.5-5.0 3.0-4.0	10:10:	D150-47T
Power factor	0.03-0.045 0.06-0.075 0.045-0.065		D150-47T

* Saran 115.

eter of saran lined pipe is slightly smaller than the corresponding standard iron pipe.

In the saran lined steel pipe, the saran liner is inserted in an over-size steel tube which is then swaged down to the accurate pipe size. This operation firmly locks in the liner so that the assembly expands and contracts as a unit. For pipe sizes greater than 6 in. saran rubber lined pipe, fittings and valves can be obtained.

Fabrication

Saran can be machined or finished on regular machine shop equipment. The usual precautions and special techniques worked out for materials which are thermoplastic in nature apply. The use of a negative rake on drills and cutting tools to prevent gouging is an example.

Saran's resistance to common solvents make adhesion by conventional techniques difficult. However, there are available several special adhesives with the required tack and internal strength to produce reasonably good bonds.

Saran's crystallinity makes it readily adaptable to various welding techniques. Hot gas welding, friction welding and radiant heat welding are all used successfully in fabricating saran. Here again special methods have been found to produce the most satisfactory results.

Properties

Perhaps the most outstanding property of saran is its resistance to most inorganic chemicals and to most organic solvents. The most important exceptions are ammonium hydroxide and some of the aromatic ketones. At elevated temperatures dioxane and tetrahydrofuran, among others, are active solvents for saran.

In addition to its excellent chemical resistance, saran is dimensionally stable, has low water absorption and is self-extinguishing. It has excellent mechanical and electrical properties and good aging qualities. Of particular note is its low coefficient of heat transfer.

Generally speaking, saran should not be recommended for services involving high-speed impact, shock or flexibility at sub-freezing temperatures. Continuous exposure of molded saran articles to temperatures above 170 deg. F. should be avoided with one notable exception in the case of saran lined steel pipe.

Here, because of the swaging operation in its manufacture, the saran is subjected to considerable compression. This results in an upgrading of the chemical resistance and of the limiting temperature to 194 deg. F. Because of its unique construction, pressures up to 350 psi. can be handled in saran lined steel pipe. The table lists some of the physical properties.

As in preceding articles in this series, actual concentrations are listed on the following charts. All tests are performed under static conditions. The information presented is intended only as a guide. Tests simulating actual conditions should be made, especially where dynamic applications such as flexure or vibration are involved.

INDEX

For your information and convenience, here is a tabulation of the materials of construction which have been covered thus far in the current

been covered thus far in the c	urrent
Corrosion Forum series:	
AluminumMay	1952
Asphaltic Mastics May	1954
Carbon & GraphiteSept.	1953
Cast High AlloysOct.	1953
Chlorimet 2Feb.	1954
Chlorimet 3	1954
Durimet 20-Carpenter	
20Dec.	1953
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Furane CementsDec.	1951
Glassed Steel Mar.	1953
Hastelloys C,	
B & DJune-Aug.	1952
High Impact StyreneJan.	1953
High Silicon Iron Jan.	1954
Lead & Lead Alloys Feb.	1953
Phenolic CementsJan.	1952
PolyethyleneOct.	1952
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chloroethylene June	1954
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SaranJuly	1954
Silicate Cements Mar.	1952
Stainless Steels AprAug.	1953
Sulphur CementsFeb.	1952
Tantalum	1952
Tantalum	1952
WorthiteNov.	1953
Zirconium Sept.	1953

Reprints of most of the above are available at 50 c. each. (Hastelloys and Stainless Steels, 75 c. each.) Address Reprint Dept., Chemical Engineering, 330 W. 42 St., New York 36, N. Y.



A bank of Durimet 20 Durcopumps handling manganese sulfate solution with 3% free sulfuric acid, a portion of the new Knoxville plant enabling Electro Manganese to double its production capacity.

Another new plant—another exclusive

DURCOPUMP

installation...

"These pumps really get rugged service" at

ELECTRO MANGANESE CORPORATION



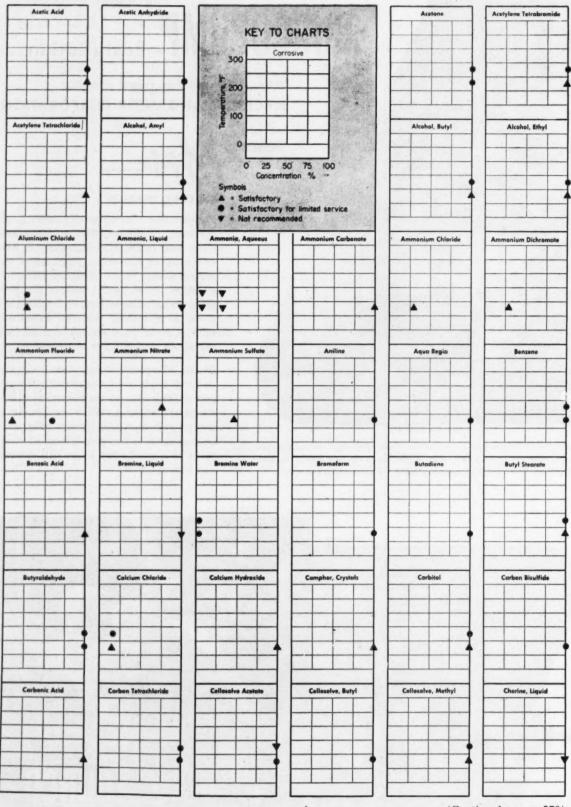
KNOXVILLE, TENNESSEE

For dependable pump service under tough operating conditions, Electro Manganese Corp. went to DURCO exclusively in their new plant in Knoxville, Tenn. All of the process pumps in this plant are DURCO-PUMPS. These handle various corrosive solutions including sulfuric acid, cell liquors made up of sulfuric acid and manganese sulfate, muds from settling and filtering operations, and abrasive waste slurries.

Electro Manganese Corporation is the sole domestic producer of pure electrolytic manganese (99.9+%) for the metallurgical and chemical industries. Electromanganese is widely used as an alloying and sulfur controlling agent in the manufacture of stainless and special alloy steels and various non-ferrous alloys.

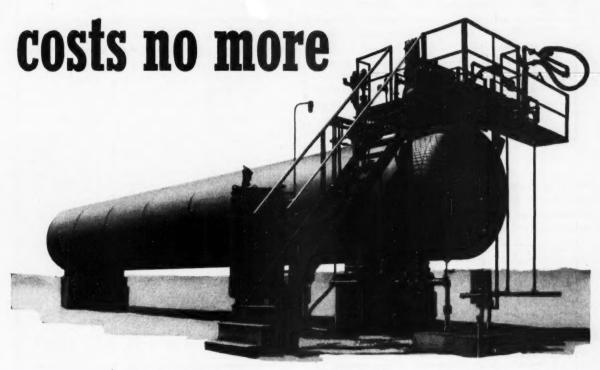


Corrosion Resistance of Saran



(Continued on page 270)

Superior Quality



Price tags on tanks for liquefied petroleum gas and anhydrous ammonia are deceiving! All tanks may look alike, but there can be a tremendous difference in *quality*. The quality you must have for longer service life, for lower maintenance, for vital extra safety.

To give you that quality, Q.C.f. not only x-ray inspects every inch of welded seam, but because of stresses set up by fusion welding, completely stress relieves the entire tank. Few manufacturers do this!

Such operations guarantee safety and provide the superior Q.C.f. quality—yet the cost to the tank purchaser is comparable in price to the tanks that are not x-rayed or stress relieved.

These are just two of the reasons why Q.C.£ tanks are unmatched for value! Why take unnecessary risks? Ask a courteous Q.C.£. Representative for the complete facts today, or send for descriptive literature. A.C.F. Industries, Incorporated, New York • Chicago • St. Louis • Cleveland • Washington • Philadelphia • San Francisco.

Q.C.f.







Quality you can trust

Corrosion Resistance of Saran

Chlerine Water	Chlore Acetyl Chloride	1-Chiero, 1-Nitropropane	Chlorosulfanic Acid	Chromic Acid	Citric Acid
+					
	1 •	1 1			
			1	A	
1					
Copper Sulfate	Cupric Chloride	Cyclohexane	Cyclohexanone	Diacetone Alcohol	1,2-Dibromo Ethan
Dibutyl Phthalate	Dibutyl Sebacate	1,2-Dichlerebenzene	Diethyl Ether	Disctyl Phthalate	Ethyl Acetate
	District Sections	7,2-50,000,000,000	Diemyr Emer	Discryi Frindiale	Emyl Acetate
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hylene Dichloride	Ethylene Oxide	Ethyl Menachiaracetate	Ferric Chloride (Crystal)	Ferrous Sulfate	Freen F12 and F22
					*
		•		•	
	1			•	
					Gas and liquid
					Sas and liquid
Furfured	Formaldehyde	Gasaline	Glycerel Triacetate	Hydrochloric Acid	Hydrofluoric Acid
Furfural	Formaldehyde	Gasaline	Glycerol Triacetate	Hydrochloric Acid	Hydrofluoric Acid
Furfural	Formaldehyde	Gasaline	Glycerol Triacetate	Hydrochloric Acid	Hydrefluoric Acid
Furtural	Formaldehyda	Gaseline	Glycerol Triucetate		Hydrofluoric Acid
Furfurel	Formuldehyde	Gaseline	Glycerol Triacetate	Hydrochloric Acid	
Furfural	Formaldwhyde	Gasaline	Glycerol Triocetate		Hydrofluoric Acid
Furfural	Furmaldehyde	Gasaline	Glycerol Triacetate		
Furfural		Gasaline	Glycerol Triacetate	• •	
Furfural			Glycerol Triacetate	• •	
Furfural		Goseline Leaded and unleaded	Glycerol Triocetote	• •	
			Glycerol Triocetate	• •	
	A	Leaded and unleaded		• • • • • • • • • • • • • • • • • • •	•
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	A	Leaded and unleaded		Lithium Bromide	•
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	A	Leaded and unleaded		Lithium Bromide	•
	A	Leaded and unleaded		Lithium Bromide	•
drogen Peroxide	Isdine Crysiols	Leaded and unleaded Kerosene	Linseed Oil	Lithium Bromide	Lub Oil SAE 30
drogen Peroxide	A	Leaded and unleaded		Lithium Bromide	•
drogen Peroxide	Isdine Crysiols	Leaded and unleaded Kerosene	Linseed Oil	Lithium Bromide	Lub Oil SAE 30
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rdrogen Peraxide	Isdine Crysiols	Leaded and unleaded Kerosene	Linseed Oil	Lithium Bromide	Lub Oil SAE 30
rdrogen Peraxide	Audine Crystals Manganese Sulfate	Leaded and unleaded Kerosene	Linseed Oil	Lithium Bromide	Lub Oil SAE 30
Furfural Purfural pdrogen Peraxide	Audine Crystals Manganese Sulfate	Leaded and unleaded Kerosene	Linseed Oil	Lithium Bromide	Lub Oil SAE 30
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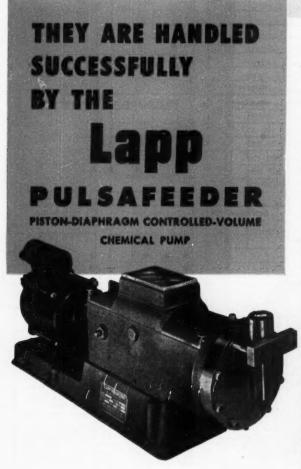
THESE FLUIDS ARE DIFFICULT TO PUMP

ACETALDEHYDE
ACETONE
FORMALDEHYDE
FREON
MERCAPTANS
MERCURY
MOLTEN METALS
NAPHTHALENE (Molten)
NITRIC ACID
PHOSPHORIC ACID

SODIUM CYANIDE
SULFUR DIOXIDE
TRINITROCHLOROBENZENE
VINYLIDENE CHLORIDE
CHLOROSULFONIC ACID
CHROMIC ACID
HYDROBROMIC ACID
NITRIC ACID
OLEUM
OXALIC ACID

PROPIONIC ACID
SULFURIC ACID
IODINE
BENZOLCHLORIDE
BENZOLTRICHLORIDE
LIQUID BROMINE
CHLORACETIC ACID
DILUTE ACIDS
ALUMINUM SULFATE
DIATOMACEOUS
EARTH SLURRY
FERRIC SULFATE
SODIUM HYPOCHLORITE

SALT SOLUTIONS
SODIUM SILICOFLUORIDE
HYDROGEN PEROXIDE
HYDROCHLORIC ACID
BROMINE TRIFLUORIDE
CHLORINE
CHLORINE TRIFLUORIDE
FLUORINE GAS
HYDROFLUORIC ACID
HYDROGEN CYANIDE
HYDROGEN FLUORIDE
FLUORINE
SULFUR DICHLORIDE



Not competitive with any pump of more conventional design, the Lapp PULSAFEEDER is a highly specialized, precision, custom-built machine suited to a wide variety of special applications involving controlled-volume pumping of fluids.

Basic feature of Lapp PULSAFEEDER design is its combination of reciprocating piston action (to provide the accuracy of positive displacement) with an hydraulically balanced diaphragm which isolates material being pumped from working pump parts—and, of course, eliminates need for stuffing box or running seal.

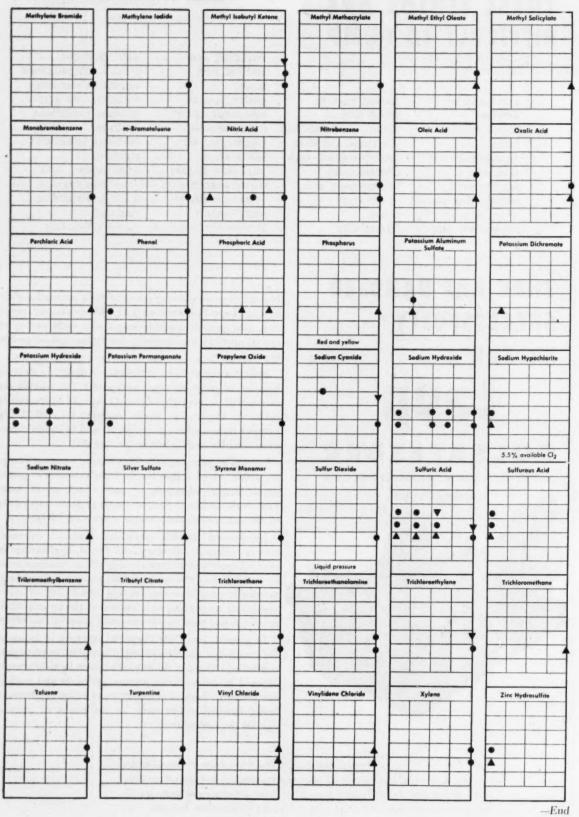
Control of pumping rate is achieved at constant pumping speed; variable flow results from variation in piston stroke length—adjustable by hand-wheel, or, in Auto-Pneumatic models, by instrument air pressure responding to any instrument-measureable processing variable.

Justification for this specialized premium construction is evident in the many, and varied, applications in which Lapp PULSAFEEDER alone is able to perform satisfactorily. In fact, the economies of continuous processing, automatic proportioning, feeding and filling in many operations are possible only because of the unusual characteristics and peculiar advantages of Lapp PULSAFEEDER.

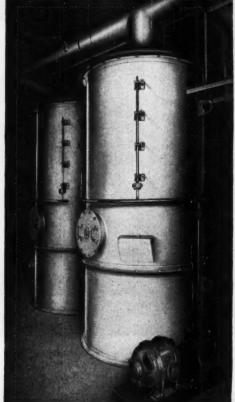
In general, use of the Lapp PULSAFEEDER is indicated for continuous (or intermittent) pumping, at accurately controlled volume, of fluids which cannot be satisfactorily exposed to conventional pistons, cylinders and stuffing box packing—because of the corrosive action of chemicals being handled and/or need for protection of product against contamination.

Lapp Bulletin 300 shows typical applications and flow charts. It describes and lists specifications of models over a wide range of capacities and special constructions. Also included is an Inquiry Data Sheet, from which we can make specific engineering recommendations for your processing requirement. For your copy write Lapp Insulator Co., Inc., Process Equipment Div., 345 Wilson St., Le Roy, N.Y.

Corrosion Resistance of Saran



DUSTand FUNDS



Special equipment engineered to solve individual problems posed by dusts of all kinds, fly ash, chemical fumes, gases of any temperature, aerosols, and other troublesome air polluents

In dealing with air contaminants, each individual air cleaning problem must be approached with a view to determining what type of collector or filter is required to produce maximum results under existing conditions. Study and analysis of the character and extent of the polluent is therefore imperative in arriving at a satisfactory solution. Mahon dust and fume control engineers have, over a period of years, developed and perfected special Wet and Dry Collectors and Fog-Filters which have proved highly successful in coping with all types of industrial air contaminants—a few are illustrated here . . . they are serving today in some of the most difficult and mandatory air cleaning jobs in industry. Each installation has been engineered to do the specific job. If you have an air pollution problem, regardless of its character, it will pay you to call in a Mahon engineer and let him show you what Mahon equipment has done with like polluents under conditions comparable to your own. See Mahon's Insert in Sweet's Mechanical Industries File for further information, or write for Industrial Equipment Catalog A-654.

THE R. C. MAHON COMPANY

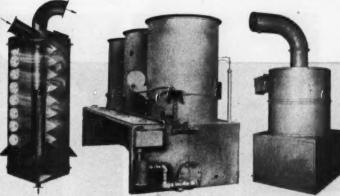
Main Plant and Home Office, Detroit 34, Michigan

Engineers and Manufacturers of Dust and Fume Control Equipment Including Cyclone Collectors, Hydro-Foam Collectors, Jet Trap Collectors, Hydro-Filter Collectors, and Fog-Filters and Cupola Stack Washers.

All Mahon Equipment is Erected by Mahon to Insure Complete Satisfaction.

MAHON FOG-FILTERS AT WORK

The installation illustrated above was specially designed for the Motor State Oil & Grease Co., Jackson, Mich. PROBLEM: To eliminate M₂S ador from sulphonated grease manufacturing operations. The problem was complicated by grease and oil fumes present in M₂S gas. SOLUTION: A two-tower Fag-Filter connected in series was designed with high pressure water fag collecting practically all of the grease and oil fumes in the first tower. A caustic solution employed in the second tower and fagged at lower pressure removes the remaining H₂S from the air before it is exhausted into the atmosphere.



Fog-Filter

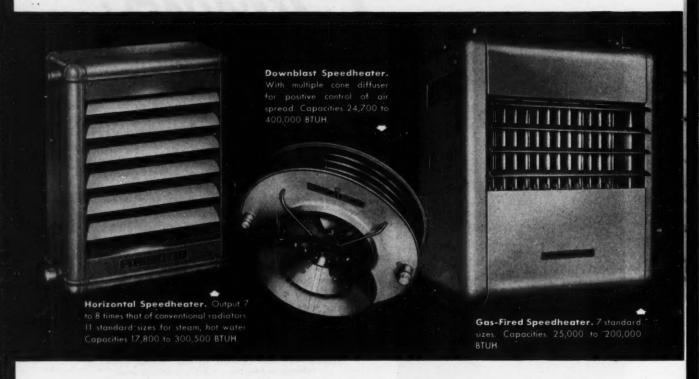
Hydro-Foam Dust Collector

Jet Trap Dust Collector

MAHON

FLOW HEAT EVENLY OVER LARGE AREAS . . .

Westinghouse Speedheaters®



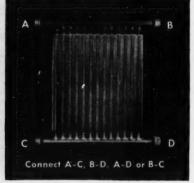
Outstanding features assure quiet, reliable operation . . . easy installation:



Plete fine cut noise, maintain uniformair flow, minimize clogging of coil with dirt and dust. Adjustable louvers spot or spread heat directly into work zone. Unit requires no warm-up—a flip of a switch generates instant heat.



Pliable steel hengers, a Westinghouse exclusive, simplify installation of Horizontal Speedheaters. Heavy-gauge welded steel casings, heavy seamless copper tubes, rugged motor and fan increase service life.



Four connection combinations further simplify installation of Westinghouse Horizontal Speedheaters... reduce piping costs... allow flexibility in installation to fit varied unit and piping locations.

Spread Instant Heat on Work Zones

Modern-design Speedheaters slash fuel costs up to 25% when used as complete systems or supplements to existing central systems.

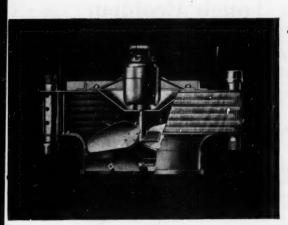
These three Westinghouse Speedheaters provide instant, low-cost heat—where and when you want it—for applications ranging from spotting heat into small areas, to spreading heat comfortably and efficiently over large work zones. Both dependable and attractive, they are ideal for stores, offices, factories, warehouses—anyplace, in fact, requiring quick, uniform heat at lowest cost.

Westinghouse Speedheaters go to work immediately. Their *instant heat* eliminates fuel loss... saves, as proved in installations across the country, up to 25 per cent in fuel costs over old-style heating systems. Available in sizes from 17,800 to 400,000

BTUH, these Speedheaters supplement your present central system for most effective heat coverage . . . or satisfy, through flexible unit selection and placement, your entire heating needs.

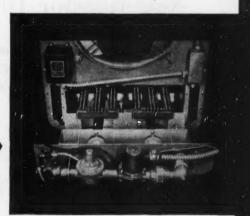
Check on these versatile units today. Call the Westinghouse-Sturtevant representative conveniently located in your area, or write Westinghouse Electric Corporation, Sturtevant Division, Boston 36, Mass.

For specifications, dimensions, performance data, send today for CATALOGS 1521 (Steam—Hot Water) and 1525 (Gas-Fired)



For buildings with high collings, Westinghouse Downblast Speedheaters are ideal. Powerful fans and directional vanes project heated air down to work levels, blanketing large areas with effective, economical heat even where equipment and partitions obstruct circulation.

Fully automatic Gas-Fired Speedheaters climinate need for central heating plants...run on low-cost natural, manufactured or LP gas. Units have seal of approval of AGA Testing Laboratories.

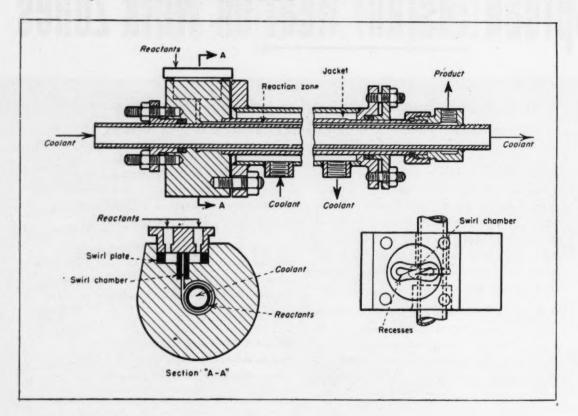


WESTINGHOUSE AIR HANDLING

YOU CAN BE SURE ... IF IT'S Westinghouse

Tomorrow's Technology Melvin Nord, Chemical Engineer & Patent Attorney, Detroit, Mich.

NEW EQUIPMENT PATENTS



New Reactor Design Solves a Tough Problem

Given: A highly exothermic reaction between immiscible liquids. Problem: Provide rapid mixing and proper temperature control. Solution: This new design.

All the essentials for netting the maximum yield from a highly exothermic reaction between immiscible liquids are anchored in a recently revealed reactor design.

A "swirl chamber" provides rapid mixing of the reactants and insures proper dispersion with a minimum of turbulence. This dispersion passes immediately to a second chamber, characterized by an extensive heat transfer area.

► How It Works—For a clearer picture of how the apparatus works,

let's look at a typical rapid, highly exothermic reaction—sulfonation of olefins with sulfuric acid.

The two immiscible liquids feed tangentially into the swirl chamber—a long, thin, tube-like affair where the whirlpool effect, caused by the tangential feeding arrangement, insures rapid, thorough mixing.

The reaction starts immediately on contact. And the dispersion goes at once to the reaction zone. It flows into this chamber tangentially and moves through it with a minimum of turbulence. A large heat-transfer-surface-to-volume ratio makes for good temperature control.

Reaction products exit from the end of this chamber.

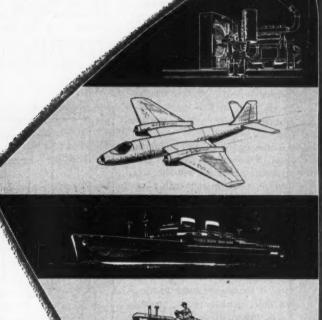
► Swirl Chamber Details—A pair of recesses are set in a plate in such a way that they direct the incoming liquids tangentially into a chamber in the center of the plate. Rapid mixing takes place here.

The chamber diameter is small compared to its length. Capacity also is small—the materials stay only long enough to insure proper dispersion.

▶ Reaction Zone Details—A nozzle passes the dispersion tangentially



FULL-FLOW FUEL LUBE HYDRAULIC AIR



Preferred by more ORIGINAL EQUIPMENT MANUFACTURERS than any other make—

Next time the question of filtration comes up, here's something worth remembering—

The majority of America's best known builders of internal combustion equipment choose Purolator* filters. In most instances, their choice is based on results of their own impartial tests. Purolator filters—inch for inch, and pound for pound—give finer, more dependable filtration at optimum flow rates.

Quickest way to get acquainted with the almost one thousand different types of Puzolator filters is to send for the catalogs. Use the coupon!

PUROLATOR PRODUCTS, INC.
Rahway, New Jersey and Terento, Ontario, Canada
Factory Branch Offices: Chicago, Detroit, Los Angeles



Do you have a problem in filtration?

Purolator maintains the world's largest specialized filter research and engineering laboratories. Your filter problems—small or large—are always welcome at Purolator's Engineering Department.

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into the annular reaction chamber. The dispersion then moves through the reaction zone as a helically advancing current.

This swirling motion results in continuous mixing throughout the zone—without the need for a turbulence-causing high flow velocity. Excess and random turbulence—causing undesirably high reaction rates—are avoided.

▶ Removing the Heat—The annular shape of the reaction chamber gives a maximum heat transfer area. Coolant is run through both a concentric inner tube and an outer jacket.

The reactor can also be used for endothermic reactions — although the problem of adding the heat of reaction is generally less acute than the problem of removing it. As such, it is only necessary to use a hot fluid, in place of the coolant.

The patent, U. S. 2,671,645, by Marinus Buis was assigned to Shell Development Co.

New Spray Dryer Boasts Capacity Hike

Split your heat source and you'll up the capacity of your spray dryer. That's the claim of a new spray dryer design.

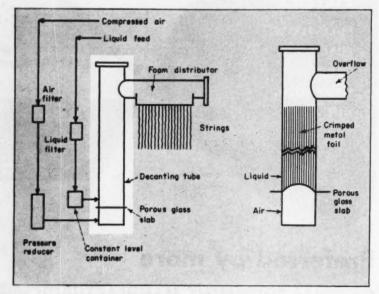
Fundamentally, there are two ways to boost the capacity of a spray dryer: Either raise the temperature of the drying gases or use more of them. However, should you attempt either, you may run into difficulties.

- Using temperatures above 750 deg. F., you stand a good chance of damaging the spray device.
- Increasing the volume of hot gases significantly spells a corresponding size increase in the entire installation.
- ► How It Works—To skirt these limitations, the new design splits the flow of hot gases into two separate streams.

A furnace installation connected directly to the dryer supplies a portion of the total gas volume at 750 deg. F—up near the spray device—and the remainder at 2,500 deg. F.—away from the spray in the lower part of the dryer.

When the average temperature between the top and bottom inlet streams is 1,100 deg. F., it is claimed that a 67 percent increase in capacity results. The dryer design is such that the temperature and volume of exit gases are the same as with normal temperatures.

William L. Spaulding, the inventor, has assigned his patent, U. S. 2,670,036, to American Cyanamid Co.



Foam Screen Licks a Dust Control Poser

A layer of foam can be used to catch those very fine dust particles which defy other modes of collection. The foam's high wetting power is responsible for its topnotch dust collecting ability.

To take advantage of this ability, a new apparatus has been designed which generates the foam in the form of a screen—through which dust-laden air or gases can pass.

► Foam Characteristics—The foam generated has high wetting power and good stability. Consistency is such that the air bubbles within it are 1 to 10 mm. in diameter, and thickness of the film is 1 to 10 microns.

The high wettability enables the foam to wet and collect particles that water-because of its higher surface tension-will not wet.

► Equipment Workings—Clean air at 1 to 5 psig is supplied via a filter and a pressure reducing valve.

Liquid—preferably water containing about 1 percent wetting agent and 1 percent stabilizer—passes through a filter and a constant level container into the decanting tube.

Air flows through the foam generator (a porous glass slab) at the bottom of the decanting tube and combines with liquid to form the foam.

The decanting tube contains spiral-shaped pieces of crimped metal foil. These provide a large contact surface for the foam as it rises in the tube. From the decanter, the foam enters a horizontal tube carrying the foam distributor.

The distributor has a number of slits through which the foam exits. Strings hanging from the distributor slow the flow rate of the foam and form it into a screen.

Louis H. A. Foulon describes the apparatus in his patent, U. S. 2,672,209.

FACTS ON INFRARED FOR THE PROCESS PLANT THE ONLY COMPLETE RANGE OF INFRARED INSTRUMENTS TO MEET ALL REQUIREMENTS FOR THE PRO-

Which costs more... waste product? or infrared analyzers?

Infrared analyzers are expensive, but sub-standard products can be even more costly. You can nip waste production runs in the bud by monitoring your process stream with infrared analyzers. Significant changes in stream composition can be detected *immediately*, in time to prevent off-quality material. Once installed, the instruments pay for themselves in a few weeks of operation.

Among commercially available instruments, Perkin-Elmer's TRI-NON and BICHROMATOR Analyzers are probably the most expensive—and with good reason. They are based on unique optical principles that permit greater sensitivity and wider application than other analyzers. They are engineered to operate for long periods under difficult plant conditions. Perkin-Elmer's unique "unitized" construction permits easy servicing and prompt replacement of defective components. The BICHROMATOR and TRI-NON Analyzers are completely sensitized and adjusted to meet your specific process stream problems before leaving our plant. And, most important, they are backed by Perkin-Elmer—an organization with more experience in infrared instrumentation than any other in the world.

Full particulars on our infrared process control analyzers and services are yours for the asking. Fill in the coupon below.

FOR THE PILOT PLANT—Model 14 Michi-Component Analyzer— Continuously records the concentration of up to aix components in a pilot process stream on a six-namula cycle, ideal for tracking the effects of temperature, pressore, etc., changes in a pilot stream.



FOR THE PROCESS PLANT—Medal \$3 STORMORATOR* Already to -For continuous control of liquid or gas streams, financial the ratio of any two wavelengths chosen. Thermospottod, enclosed in explasion-proof containers.

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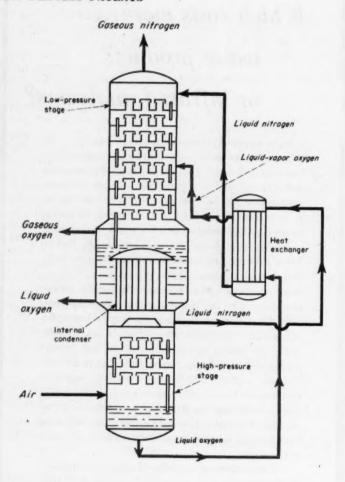
PERKIN WELMER

Model 14..... Models 93 and 105.....

TITLE.....

ADDRESS.

CHEMICAL ENGINEERING-July 1954



New Set-Up for Air Splitting

Add another heat exchanger to the conventional double column fractionation. The three-fold result: less entrainment, better reflux, lower oxygen losses.

One piece of equipment—a heat exchanger—added to the conventional double column apparatus for air fractionation can mean a more efficient recovery of the gases for you.

Nitrogen Separates—In the new operation, pre-cooled, partially liquified air at 75 psig. enters the lower section of the column. Gaseous nitrogen separates out here, leaving crude oxygen.

Nitrogen vapors flow from the lower section into an internal condenser and are liquified. Part of the liquid returns to the reflux plates of the lower section of the column, the remainder collects on an annular tray.

From this tray, liquid nitrogen passes via the heat exchanger to the upper section of the column, where it acts as a reflux. This upper section is maintained at a low pressure—about 5 psig. In passing from the higher to lower pressure section, some of the liquid nitrogen evaporates, leaving the column as saturated vapor.

► Oxygen Separates—Crude oxygen

from the bottom of the lower section of the column goes through the heat exchanger and expands into the upper part at an intermediate feed point.

The upper plates make the final separation. Gaseous nitrogen exits from the tower top. And liquid oxygen, collected in a pool around the internal condenser, comes off the column at the bottom of the upper section.

▶ Internal Condenser – Because of the difference in boiling points of oxygen and nitrogen, the pressure in the lower stage rises—until it stabilizes at the point where nitrogen in the internal condenser is at a temperature slightly higher than that of the oxygen pool above it. Thus the internal condenser acts as a reboiler for the oxygen in the low-pressure upper section – the temperature differential keeping the oxygen boiling constantly.

▶ Heat Exchanger—Adding the heat exchanger to the system removes heat from the liquid nitrogen as it passes from the high to the low pressure stage. Heat removal is accomplished by cooling with crude oxygen, which comes to the exchanger via an expansion valve.

Heat from the nitrogen vaporizes some of the oxygen. And the vaporliquid oxygen mist then goes to the low-pressure, or upper, stage of the column.

► Advantages of the New-Here's how the added exchanger improves the fractionation:

 Vaporization of liquid nitrogen as it passes into the low pressure zone is minimized by cooling.

 Entrainment of liquid in the nitrogen vapor leaving the column is thereby reduced.

 Loss of oxygen due to nitrogen vaporization in the low pressure zone is also cut.

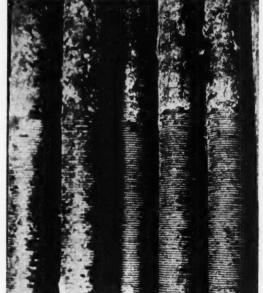
 Reflux to the upper column plates is hiked. This not only cuts down on the number of plates required but also boosts the oxygen yield.

Clarence J. Shilling is responsible for this new development. He has assigned his patent, U. S. 2,672,031, to Air Products Inc.

Here's Proof Positive!

WOLVERINE TRUFIN*

retains surface advantage over prime surface tube during



operating period

Here's an on-the-spot, unretouched photo of Trufin type S/T and prime surface tube after one year's service.

And here's a graph which shows the result of a test using a dirty No. 5 fuel oil to determine the fouling characteristics of Trufin and plain tube. Note that the tubes foul at about the same rate. In fact, there is proof that in some installations Trufin more than maintains its surface advantage over long periods of operation.

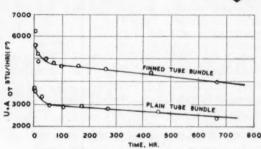


FIGURE 2-VARIATION OF HEAT TRANSFER PERFORMANCE WITH TIME

Evidence like this indicates that re-tubing with Trufin gives you more shell side effective heat transfer surface area in the same space . . . that you can do a bigger job than ever. Because Trufin S/T is designed primarily for shell and tube exchangers, you will get every bit as much service from your new installation as your old—plus added heat transfer capacity. And because the fins of Trufin are integral,

high fin efficiency is maintained in spite of thermal shock or vibration.

Wolverine furnishes Trufin in a variety of metals: copper and copper-base alloys, aluminum, bi-metal, electric-welded and stainless steel. You can get help in selecting the right one from Wolverine's Field Engineering Service. Let us help you consider the advantages of finned tube in your next installation.

Wolverine Trufin available in Canada through the Unifin Tube Company, London, Ontario,

More information? Write for a copy of Wolverine's Condenser Tube Booklet. It's crammed with information you can use! Wolverine Tube Division of Calumet & Hecla, Inc., 1443 Central Avenue, Detroit 9, Michigan.



WOLVERINE TUBE DIVISION

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Manufacturers of Quality Controlled Jubing

PLANTS IN DETROIT, MICHIGAN AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIES.

Another Job For Ion Exchange

Ion exchange, a versatile tool for difficult separations, has come through with flying colors on one of its biggest jobs to date—concentrating magnesium from sea water.

The final concentration of magnesium from the new, continuous ion exchange process is more than-40 times as great as in the ocean water used as starting material.

▶ Process Flow—Sea water, containing 0.43 percent by weight sodium ions, 0.0685 percent magnesium ions and 0.99 percent chloride ions and with a specific gravity of 1.012 at room temperature, feeds into the bottom of the first of two columns. An exchanger regenerant solution, containing 10.18 percent by weight sodium ions, 0.007 percent magnesium ions and 14.58 percent chloride ions and with a specific gravity of 1.192 at room temperature feeds into the bottom of column 2.

The ocean water travels up the column and comes off at the top depleted in magnesium ions. Product, containing about 10.53 percent by weight magnesium chloride and 8.51 percent sodium chloride, comes off the second column.

► Moving the Resin – A granular cation exchange agent is used in the process. It consists of a sulfonated copolymer of styrene and minor amounts of ar-ethylvinylbenzene and divinylbenzene. The resin is circulated continuously through both columns.

Star valves control resin removal from the bottom of each column. This resin is then picked up in a fresh water jet and sent to the top of the other column. Gravity moves it down through the column.

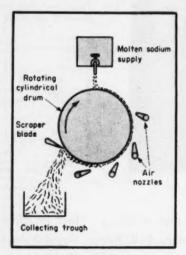
Separating The Water—In the first column, where the magnesium is knocked out of the sea water, the fresh water bringing the resin in is removed with the spent sea water.

In column 2 the situation is more complex—since it is necessary to prevent dilution of the product. A difference in electrical resistance between the water and the product solution is the key to the separation.

Several pairs of electrodes, spaced throughout the top part of the column, determine the position of the interface between the two liquid layers and regulate removal rates.

A lamp and photoelectric cell are used to determine the level of the loose bed of ion exchange material in the column. This cell automatically controls the flow of water to the resin-pick-up jet, and thereby regulates the feed of resin to the column.

The new process is described by William F. McIlhenny and Vernon O. McConnell in U.S. 2,671,714. Their patent is assigned to The Dow Chemical Co.



Sodium Peroxide Goes Off the Wagon

Exposing a thin film of molten sodium to an oxidizing atmosphere and elevated temperatures is the key to a new and novel process for the manufacture of sodium peroxide. This looms as a big improvement over older methods of carrying out the reaction—either in heated revolving drums or by placing sodium in wagons and moving these wagons through a furnace.

The new method does away with all this by continuously oxidizing a molten sodium film on a rotating cylindrical drum. Film thickness (about 1mm.) is regulated by the sodium flow and the drum rotational speed.

► Streams of Dry Air—A number of nozzles located along the cylinder's periphery direct streams of anhydrous air against the sodium on the drum. This converts it to the peroxide form.

Product is removed from the drum by a scraper blade, and falls into a collecting trough.

▶ Heat Still Needed—Although the sodium oxidation reaction is exothermic, not enough heat is liberated to keep the reaction going. It is necessary, therefore, to mount an oil burner at one end of the drum—connecting a chimney or vent at the other end—to maintain the necessary 840-1,070 deg, F.

The entire apparatus is mounted in a housing (not shown) which is sealed except for a vent to permit the escape of excess air.

This new method was described in U. S. 2,671,010, issued to Luke J. Governale and assigned to the Ethyl Corp.

Complex Formation Key To Olefin Purification

Here's an improved process for the production of purer olefins. It hinges on the formation of a liquid complex with silver nitrate (in the presence of small amounts of solvent).

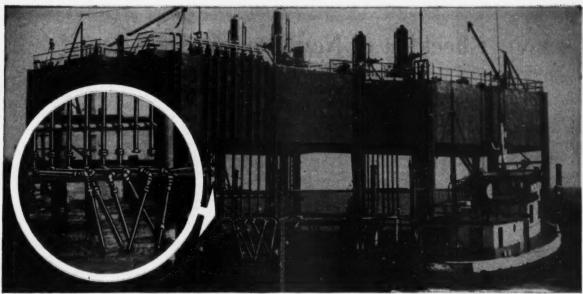
The new procedure has an edge over other methods employing aqueous or solid silver nitrate in that:

- Lower concentrations of olefins in the feed are permissible.
- All olefins are associated with the silver nitrate.
- Greater throughput is achieved.

Results of experiments — using either water or acetonitrile as solvent—are eited in the patent, U. S. 2,673,225.

Alfred W. Francis, the inventor, has assigned his patent to Socony Vacuum Oil Co., Inc.

This department is designed to keep you abreast of the latest developments in chemical equipment and processes. Any patents may be ordered from the Commissioner of Patents, Washington 25, D. C. The cost: 25 cents.



Chiksan swivel joints are used on the 12 underwater lines on this portable submersible tank battery barge which stores oil from 12 wells. Three swivel joints are used on each line to provide necessary flexibility and safety against storms, wind and waves. Visible in this photograph are style 50 Chiksan joints. Style 10 and style 50 joints are below the surface.



Each submersible tank battery has a 6" or 8" CHIKSAN aluminum Marine and Barge Loading Hose that permits unloading of oil to the barges.



After 3 years of under-water service this CHIKSAN Marine Swivel Joint has been raised from 14 feet of water 13 miles from share to service the packing.



Same CHIKSAN joint being cleaned of marine growth after re-packing and preparatory to re-submerging for years were of safe and economical service.

Davey Jones' Locker

IS FULL OF CHINSAN MARINE
SWIVEL JOINTS...3 Years of Storms, Wind
and Waves Have Proved the Flexibility, Economy and Safety of
CHIKSAN Marine Swivel Joints in Submerged Salt Water Service.

In the bays along the Texas and Louisiana Gulf Coast submersible tank-battery barge storage and transfer of oil has been made both possible and practicable with the application of CHIKSAN Marine Swivel Joints to the under-water flow lines.

In waters that range from 8 to 35 feet deep and with pressures up to 2100 psi. CHIKSAN joints have given the necessary flexibility of flow lines, economy of transport and safety of operation in transferring oil for distances in excess of 13 miles under water without line rupture or loss of product. Tight bends and connections on the flow lines between well platforms, tank batteries, metering platforms or drilling structures in the operation of off-shore locations that could not withstand the "Sunday Punch" of wind, waves and dragging boat anchors, are eliminated by the use of CHIKSAN swivel joints.

CHIKSAN'S special design submersible Marine Swivel Joints have once again solved a costly and perplexing problem of the Petroleum Industry.

Write CHIKSAN Engineering and Research for complete details. Dept. 7-CE

The Flow of Enterprise Relies on

CHIKSAN

Ball-Bearing Swivel Joints
THE NEW TOOLOF MODERN INDUSTRY

36

CHIKSAN Ball
Bearing Swivel Joints are
THE NEW TOOL of
Modern Industry with full
360° rotation in 1, 2, and 3
planes. Over 1,000
different types, styles,
and sizes have been
developed for pressures
and services from 28"
vacuum to 15,000 psi
and for temperature
ranges from minus 70"
to a plus 500° F, with
packing materials for
each specific service.

CHIKSAN COMPANY • BREA, CALIFORNIA • Chicage 3, Illinois • Newark 2, New Jersey
Well Equipment Mfg. Corp. (Division), Houston 1, Texas • Subsidiaries: Chiksan Export Co., Brea, Calif.; Newark 2, N. J. • Chiksan of Canada Ltd., Edmonton, Alta.

Your Checklist of New Equipment Patents

		1	
Operation ,	About	Inventor or Assignee	Patent No
Chemical reaction	Synthesis gas generator	Hydrocarbon Research, Inc	2.672,849
Crushing and grinding	Converter and quencher for hydrocarbons	Phillips Petroleum Co The Babcock & Wilcox Co	2.673.786
Crusning and grinding	Air-swept ball and ring pulveriser	Monolith Portland Cement Co	2,670,138 2,670,139
	Lifting shelf of Bradford breaker mill	Pennsylvania Crusher Co	2,670,140
C . W	Jaw crusher	Einar H. Anderson	2,670,141
Crystallization	Apparatus for crystalline ammonium sulfate production.	Koppers Co., Inc.	2.670.011
Debumidification	Means for recovering vapors and solids from gas		
Distillation	Apparatus for high vacuum distillation	Standard Oil Development Co	2,664,968
Drying	Gas dryer.	Shell Development Co. Gunnar C. F. Asker	2.671.053 2.671.525
	Apparatus for drying a layer of coal	Heyl & Patternon, Inc.	2.671.968
	Drying oven for molds and cores	Carl F. Mayer	2.671,969
	Pneumatie loek control in granular stock vacuum- dryer.	Cohmides Bubbs	2.672.245
Evaporation	Multiple-effect falling film evaporator	Gebruder Buhler	2.672.926
Extraction	Liquid-liquid contacter	Phillips Petroleum Co.	2.672.406
Extraction	Plastie molder	The Dow Chemical Co	2,668,986
	Injection molder	Monanto Chemical Co	2,669,750
Filtration	Molding of plastic bottles	Plax Corp	2,669,752
r merkeion	automatic sediment removal	Fernand Baril	2.672.239
Flotation	Flotation machine impeller	The Galigher Co	2,673,724
Fluid and particle flow	Apparatus for treating gaseous and fluidized powder		
	streams	Carsten I. Johnsen The M. W. Kellogg Co.	2,669,974
	Controlling flow of fluidized solids. Apparatus for controlling bed depth in conversion	The M. W. Kellogg Co	2,670,193
	systems	Houdry Process Corp	2.670.278
	systems Submerged-blast sparger Solids lift disengager	Phillips Petroleum Co	2.671,652
	Solids lift disengager	Houdry Process Corp	2,672,374
Gas Absorption	Gas scrubber for cokers	Koppers Co., Inc.	2,671,651
Heat transfer	Method for making finned tubes	The Griscom-Russell Co. Standard Oil Co. (Ind.)	2,669,012 2,669,435
	Multiple flanged fin for heat exchangers	Modine Mfg. Co.	2,669,959
	Floating radial seal for regenerative heat exchangers	The Air Preheater Corp.	2,670,183
	Heat exchanger with thermal compensator	Maschinenfabrik Augsburg-Nurnberg A. G.	2,670,185
	Folded plate heat exchanger core	The Air Preheater Corp.	2,670,186.
	Assembling a liquid immersion-type electrical heat-	C. D. Patents Ltd	2,670,311
	ing unit	Electro-Therm, Inc.	2,670,529
	Adjustable axial seal for regenerative heat ex-		
Instrumentation and assert	changer	The Air Preheater Corp.	2.670,934
Instrumentation and control	Continuous record of interferometric gas analysis. Supersonic flow meter	T. H Bensinger and C. Kitsinger	2.668.471 2.669.121
	Liquid level indicator	Diamond Alkali Co.	2,669,122
Liquid-liquid separation	Floating self-adjusting liquid skimmer	Shell Development Co	2.670.848
Mixing	Solid-liquid mixer	Leo A. Wolpert	2.671.647
	Mixing a gas and liquid	Roy B. Everson	2.671,756
	Liquid mixer and homogenizer	Arthur T. Coakley	2,672,325 2,673,075
Screening	Clamp for screen frames	Richmond Mfg. Co.	2.668.621
	Attachment for vibratory screens	Fred K. Betta III	2,670,079
Solid-gas contacting	Apparatus for contacting solids with gases	Sun Oil Co	2.671.057
Solid-gas separation	Electrostatic precipitation	Power Jets (Research and Development) Ltd	2,668,599 2,668,600
	Electrical precipitator	Research Corp. The Dualtron Co	2.672,206
	Electrical precipitators	Research Corp.	2.672.207-8
	Cyclone separator for solid-gas separation	Otto Schmid	2.672.215
Solid-liquid separation	Multiple hydrocyclones	Stamicarbon N. V	2,671,560
	Slurry type liquid treating apparatus Solid-liquid separator	Infileo Inc.	2,673,181 2,673,451
Storage	Liquid storage vessel	Etablissements Nevrpic. Chicago Bridge and Iron Co	2.672.254
		Commission of Contract Contrac	elmeism.

... And New Process Patents

Product	Process	Inventor or Assignee	Patent No
Catalysts	Manufacture of aluminum fluoride catalyst	Allied Chemical & Dye Corp	2.673.139
Fats and oils	Separation of tall oil acids	Armour and Co	2,672,458
Fertilisers	Production of phosphate fertilizers	Imperial Chemical Industries Ltd.	2,673,795-6
Fuels	Separation of acid gases from coke oven gases	Koppers Co., Inc.	2,671,008
	Separation of soid gases from coke oven gases Gasification of coal	Koppers Co., Inc. Imperial Chemical Industries Ltd.	2,671,015
	Continuous manufacture of supplement gas	Surface Combustion Corp	2,671,718
	Gasification of carbonaceous solids	Standard Oil Development Co	2,672,410
	Production of fuel gas	Humphreys & Glasgow Ltd.	2,673,794
Gases	Recovery of ethylene	Standard Oil Co. (Ind)	2,670,391
	Improvement of oxygen purity	Joy Mfg. Co.	2,671,318
	Air separation	The M. W. Kellogg Co	2.671,324
	Treating ethylene-containing gares	Chempatente, Inc	2,671,791
97. 9	Separation of air	Standard Oil Development Co	2,673,456
Hydrocarbons	Vapor phase conversion of hydrocarbons. Conversion of hydrocarbons with combustion gas	The Gyro Process Co	2,668,791-3
	Conversion of hydrocarbons with combustion gas	Dian B. I G	
	and finely divided catalyst	Phillips Petroleum Co	2,669,591
Q.	Naphtha reforming process. Separation of hydrocarbons with thioures.	Standard Oil Development Co	2,670,322
to the total	Production of insoluble sulfur	Shell Development Co	2,670,344
Inorganic chemicals	Preparation of calcium carbonate composition	Mathieson Chemical Corp.	2,667,406
	Aluminum production	Calcium Carbonate Co	2,668,749
	Production of hydrogen peroxide	Kaiser Aluminum & Chemical Corp E. I. du Pont de Nemours & Co	2,668,751 2,668,753
Metals and ores	Continuous production of metallic sine from oxidie	E. I. du l'ont de Nemours & Co	2,008,700
Metals and Ores	sine ores	Singmaster & Brever	2.668.760
	Recovering metal values from leach liquors	Alfred M. Thomsen	2.670.271
	Metal oxide production	E. I. du Pont de Nemours & Co.	2,670,272 & 5
Organic chemicals	Manufacture of resorcylic acid	American Cyanamid Co	2,669,581
Configuration Constitution Configuration Con	Selective reduction of polynitro aromatics	Purdue Research Foundation	2.669.584
	Chloral manufacture	Food Machinery & Chemical Corp.	2,669,585
	Production of organic fluorine epds	Allied Chemical & Dye Corp.	2,669,590
	Continuous production of carbon disulficie	Societe des Produits Chemiques de Clamecy	2.670.277
	Methyl ethyl ketone separated from aqueous ethanol	Stanolind Oil and Gas Co	2,670,324
	Purification of phthalic anhydride by distillation	American Cyanamid Co	2.670.325
Synthesia gas and products	Converting oxygenated organic cpds, in hydrocar-		210101000
and the same of th	bon synthesis	Stanolind Oil and Cas Co	2,670,378
	Production of a synthesis gas	The Texas Co	2.761.013-4
	Catalytic hydrogenation of CO in liquid suspen-		
	sions of eatalyst	Rheinpreussen A. G. fuer Bergbau und Chemic.	2.671.103

For controlled heating of liquids and gases

CHROMALOX

Electric Circulation Heaters

including

- Water, oils and heavy fuel oils.
- Nitrogen, steam, air and other gases.
- Aroclor, Dowtherm, Prestone and other heat-transfer mediums.

Chromalox Electric Circulation Heaters are "packaged" heaters ready to install and connect wherever you need dependable heat that is efficient, economical and easy to use. They give you measured quantities of heat up to 750° F. that can be accurately controlled and maintained around the clock. May be used in series. Available in capacities from 1 kw. to 100 kw. in standard voltages.

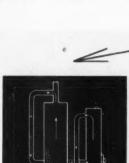
CHROMALOX CATALOG 50

contains complete data on Chromalox Circulation Heaters for all applications. Write for your copy foday.

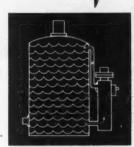


CHROMALOX

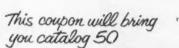
Electric Heat for Modern Industry



Circulation heater as part of nitrogen heating assembly for reactivating alumina.



Circulation heater connected to water tank as "side-arm" heater.



Industrial Division, EDWIN L. WIEG 514 Thomas Boulevard, Pittsburgh	AND COMPANY
Please send me Catalog 50.	
Name	
Company	
Street	and the second of the second o
City	Zone
State	



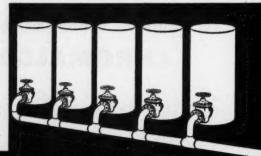
Circulation heater connected to jacketed process kettle.

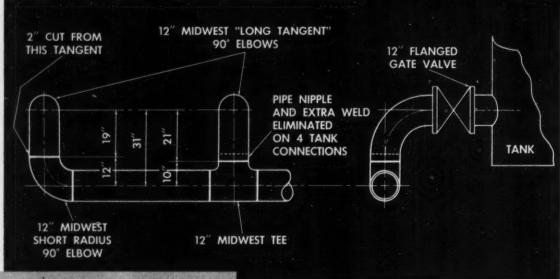


MIDWEST "LONG TANGENT" ELBOWS

\$156²⁰

On This Welding Piping





MIDWEST "LONG TANGENT" ELBOWS COST NO MORE THAN OTHER ELBOWS



The Problem:

To connect the five tanks shown in the sketch at top to a common 12" header.

The Difficulty:

The center-to-outlet dimension of the 4-12'' tees is only 10", while the shortest elbow available measures 12'' center-to-end. Thus, if standard long radius elbows are used next to the five tank valves, four short nipples and four extra 12'' welds would be required.

The Solution:

By using Midwest "Long Tangent" elbows as shown in the blueprint, the expense of the four extra nipples and welds was eliminated at the cost of just one cut! The actual net savings made by "Long Tangent" elbows on this job was \$156.20.

Remember—Midwest "Long Tangent" elbows cost no more than regular elbows! For further information, write for Catalog 54.

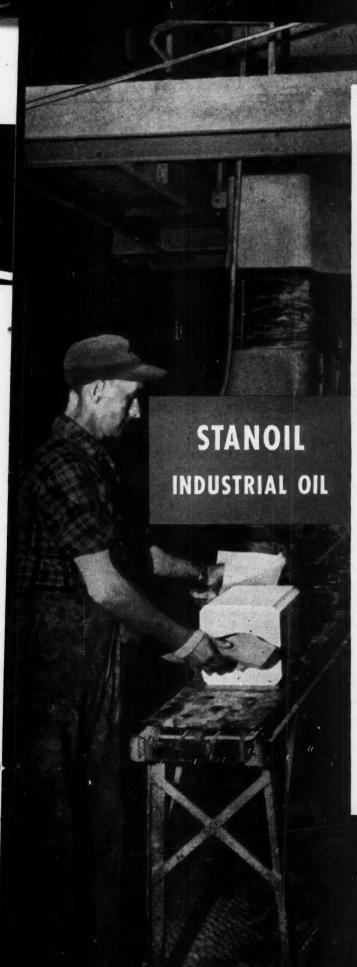
MIDWEST PIPING COMPANY, INC.

Main Office, 1450 South Second St., St. Louis 4, Missouri

PLANTS: ST. LOUIS, PASSAIC, LOS ANGELES, and BOSTON

SALES OFFICES: NEW YORK 7—50 CHURCH ST. • LOS ANGELES 33—520 ANDERSON ST. BOSTON 27—426 FIRST ST. • CHICAGO 3—79 WEST MONROE ST. TULSA 3—224 WRIGHT BLIDG. • HOUSTON 2—1213 CAPTIOL AVE.

6820





How a good oil earns its salt!

Here's a "salty" story about an oil with staying power. When this 100 ton hydraulic press was to be installed by the Morton Salt Company in their Manistee, Michigan plant, officials outlined to a Standard Oil lubrication specialist some of the rigid specifications the required oil should have. The new press would operate under a heavy load five days a week, and since the original fill would be large—22 barrels—it was important that the oil installed resist oxidation and remain in good condition for long periods.

The Standard man recommended STANOIL Industrial Oil #25, a many-purpose oil having high stability and effective rust protection. In over seven years of hard service, the oil has never been changed! During this period, periodic tests of oil samples have shown that STANOIL, despite hard service and high oil-operating temperatures, has maintained a lubricating quality comparable with a new oil.

For information on how you can best use STANOIL in your plant, check with a specially trained and experienced Standard Oil lubrication specialist. He can help you save time and money. Call your nearest Standard office, or write to Standard Oil, Chicago.



STANDARD OIL COMPANY

(Indiana)

Process Equipment News Edited by Calvin S. Cronan

NEW PROCESSING EQUIPMENT



SPLIT CAKE for better wash and . . . PAIRED FRAMES for shorter dumping time make plate and frame filter . .

A More Efficient Filter

A new plate and frame filter design promises to reverse the trend to vacuum filters. It cuts labor time, outperforms conventional press and drum filters.

Despite their long-proven merits in many process industries, plate and frame filters have been giving way to vacuum filters-primarily because 20-30 percent of time in conventional plate and frame operating cycles is taken by hand labor. As labor costs have mounted steadily, process economics have dictated the switch to labor-saving vacuum fil-

Less Labor-But the entirely new Eimco-Burwell plate and frame filter, now being readied as a catalog item by Eimco Corp., has overcome this disadvantage. In a typical 35minute cycle only 5-6 min. would be devoted to dumping; the remainder would break down as follows: feed-15 min.; wash-10-15 min.; blow-2-3 min. With labor requirements markedly reduced, two men

can keep three 30-frame Eimco-Burwells in continuous operation.

Key to success of the new design lies in the mounting of paired. frames at an angle of 180 deg. on a central shaft. Thus one frame can be rotated out of the filtration line while a clean one goes in-permitting leisurely access for maintenance of individual cloths or frames while the filter remains in operation. Ease of maintenance and simplified construction suggest a marked lifetime advantage over other wood and stainless steel filters.

▶ Better Wash-In addition to its high labor efficiency, the Eimco-Burwell also has a high wash efficiency. On a feed liquor containing about 100 gpl. of soluble tungsten values the cake is washed to a point where the soluble content of the

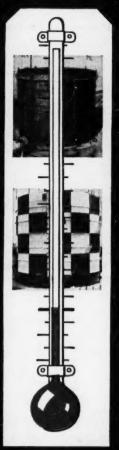
tailings is less than 0.03 percent. This represents a wash efficiency of over 99 percent, is accomplished with less than one pound of water per pound of solids.

High wash efficiency results from the fact that the feed enters the filter from the bottom. Agitation caused by the incoming feed prevents segregation of coarse and fine particles. Lack of segregation in turn results in a uniformly distributed cake, making possible uniform passage of wash water.

Bottom feed plus regulation of the amount of solids in any given batch also results in a unique split cake. The frame is not completely filled up, but rather a 1-1-in. gap is left in the center, splitting the cake into two nearly equal parts. Thus in actual practice the wash is through a half-cake rather than a full cake thickness-halving the distance soluble values must be moved and resulting in a doubled wash efficiency.

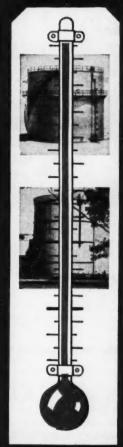
Initial installations used electric motors for turning the frames; current models are being equipped with air motors. Eimco switched to air motors because they have ex-

from the ARCTIC to the TROPICS



more than 130

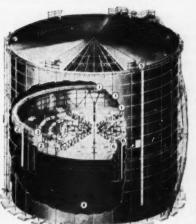
WIGGINS
GASHOLDERS
have eliminated
operating costs
for users of
chemical process
and industrial
gases



This 100% dry seal gasholder (no water, no tar, no grease) has every condition of ture. Because of the seal and the simple operating mechanism, operating costs have been entirely eliminated. Comparison of maintenance expense by owners of Wiggins gasholders also shows remarkable savings. . Companies who have converted old-type gasholders to the have been able to enjoy similar savings. Write for information.

PISTON RISES NEARLY TO TOP—MINIMUM OF WASTE SPACE CAN BE BUILT ANY SIZE • NO CONTAMINATION OF GAS

- 1. Space above piston completely ventilated
- Wide clearances simplify operation.
- 3. Gas-tight frictionless seal not affected by weather.
- 4. Piston rests on bottom when empty—less than ½ of 1% dead space for purging.
- Leveling device—independent of side wall keeps piston level.
- 6. Fenders prevent all tension in seal.



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GENERAL AMERICAN



Equipment On These Pages This Month Made News . . .

The second secon	Page Number is also Reader Service Code Number
New Processing Equipment Plate and Frame Filter	New Electrical & Mechanical Equipment Portable Floodlight 298A Storage Battery 298B Weld Backing Rings 298C Catalytic Muffler 298D Solvent-Resistant Packing 298E Bearing Compound 298F
Titanium Alloy 292D Nickel-Clad Plate 292E	New Instruments & Controls Flow Tube
New Safety Equipment Eye Shields 294A Auxiliary Trailer 294B Respirator 294C Chemical Goggle 294D Smoke Detector 294E Radiation Detector 294F	Meter Testing Station
New Heating & Cooling Equipment 296A Rotary Steam Tube Dryer 296B Vacuum Dryer 296C	New Packaging & Handling Equipment302ACorrugated Container.302BBucket Conveyor.302BAcid Wagon.302CShipping Containers.302D

. . . For more details, use Reader Service Card on page 435

tremely high torques at very low speeds and are more suitable in explosive situations. Furthermore, compressed air was already available, being used for closure of the individual diaphragms or bellows between the frames.

▶ Who Uses Them—Four of the filters are already in service at Salt Lake Tungsten Co., a fifth is in operation at a Minerals Engineering Co. plant in Montana, while a sixth is being built for use in a research project. Each of the four units in operation at Salt Lake Tungsten have 30 frames with a total of 210 sq. ft. of filter area.

Each filter handles 10 tons of dry solids per 8 hr. The slurry fed to the filter contains 50 percent solids, with the solids more than 75 percent—325 mesh. The liquor portion of the slurry contains about 100 gpl. of WO_a in solution.

Eimco believes the new filter can handle anything that can be filtered by plate and frame equipment of conventional type, plus many materials that are marginal jobs for vacuum filters. It is expected to find wide applications in the uranium industry, filtering of yeast products, and handling chemical precipitates in general, particularly where wash efficiency is a critical factor.

Discussing the filter, co-developer Blair Burwell, head of Salt Lake Tungsten, points out, "We realized plate and frame filtration was extremely sound—but awkward—in tungsten handling. What we did, in effect, was attempt to mechanize the conventional plate and frame. The Eimco people have helped us carry along our own beginnings to a highly efficient filter that should prove extremely useful in other industries besides tungsten."—Eimco Corp., 634 South Four West St., Salt Lake City, Utah. 288A

EQUIPMENT COSTS ...



Process Industries	Dec. 1953	Mar. 1954
Cement mfg	177.8	177.8
Chemical	186.4	186.4
Clay products	172.6	172.6
Glass. mfg	176.2	176.2
Paint mfg	179.5	179.5
Paper mfg	179.8	179.8
Petroleum ind	183.0	183.0
Rubber ind	185.4	185.4

Related Industries

Elec. power equip 1	88.3 188.3
Mining, milling 1	87.4 187.4
Refrigerating 2	04.9 205.1
Steam power 1	75 7 175 7

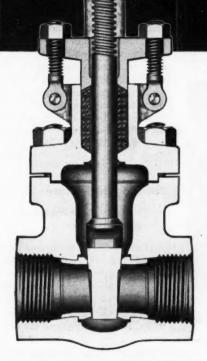
Compiled quarterly by Marshall and Stevens, evaluation engineers, Chicago and Los Angeles, See Chem-Eng., Nov. 1947, pp. 124-6 for method of obtaining index numbers; March 1954, pp 214-5 for annual averages since 1913.

You get Big Valve quality in these SMALL 600-POUND

STEEL GATES

by

CDANF



BOLTED BONNET OR UNION BONNET

In the cross-section of the bolted bonnet pattern above, you can see the rugged big-valve construction. Bolted bonnet valves available in sizes ½ to 2-inch—union bonnet valves in sizes ¼ to 2-inch.



Screwed Ends—Union



Socket-Wolding Ends-Bolto



Flanged Ends— Bolted Bonnet only

Look no further for dependable steel valves in sizes up to 2-inch. Whether you prefer the union bonnet or bolted bonnet pattern, you get refinements usually found only in larger, more expensive valves.

For example, you get a compact, weight-saving structure of highquality carbon steel. Smooth operation and positive closure of the solid wedge disc are assured by a T-head disc-stem connection and full-length machined guide ribs. There's also an unusually large stuffing box filled with high-grade packing, a leakproof bonnet joint with retained gasket, a husky stem with outside threads, and many others. To simplify maintenance, Crane design includes swinging gland eye-bolts—plus a wide yoke with liberal working space around the gland.

USER'S CHOICE OF TRIM

There's versatility to these quality Crane steel valves, too. You can have your choice of trim to suit your service—Class X Trim (Exelloy body and body seat rings) for oil or oil vapor—Class XW Trim (Exelloy seat rings, disc of hardened stainless steel) for steam or water. Union bonnet valves also available with Class L Trim (18-8 Mo Alloy seats, disc, stem) for liquids and gases up to 750° F.



Full details in 6-page folder AD-1881. Ask your Crane Representative next time he calls, or write direct.

THE BETTER QUALITY... BIGGER VALUE LINE...IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., General Offices: 836 S. Michigan Ave., Chicago 5, Illinois Branches and Wholesalers Serving All Industrial Areas



VALVES . FITTINGS . PIPE . PLUMBING . HEATING



Ceramic Lining Brick

For mills and tanks has extended wear life.

Extended service life is gained through use of the new High Density mill lining and tank lining brick. Made of an alumina ceramic the brick incorporates several desirable engineering features.

As a tank lining the material is resistant to abrasion and attack from all acids except hydrofluoric.

In one test with a lined paintplant pebble mill, a maximum wear of only in. was measured after over 17,000 hr. Present estimates put service life of this 2-in. lining at about 70,000 hr.

In the sketch are seen the new radical brick for lining mill heads. The design of the bricks, which are furnished to size, greatly reduces the number of cement joints and eliminates all corners. Rectangular brick in the cylindrical portion are double size. Lifter bars are integral parts of the 4 x 6 in. bricks.—LZP Industrial Ceramics, 2500 West 7th Ave., Denver 4, Colo.

Aluminum Alloy

Approved for construction of unfired pressure vessels.

Aluminum alloy GR40A (Alcoa's A54S) has been approved for use in the construction of unfired pressure vessels. Action was taken by the Boiler Code Committee of ASME in accordance with the rules of Section VIII of the 1952 ASME Boiler and Pressure Vessel Code.

This aluminum alloy offers higher mechanical properties than any of the aluminum alloys previously approved for welded pressure vessels. Also it maintains its strength at higher temperatures.

Although A54S alloy can be welded by all conventional methods, the inert-gas, metal-arc processes are preferred.

While more expensive than 3S and 4S alloys on an equal weight basis, it is definitely more economical on the basis of equivalent strength.—Aluminum Co. of America, 1501 Alcoa Bldg., Pittsburgh 19, Pa. 292B



Pipe Fitting Insulation

Molded in preformed halves installs with ease.

Designed for rapid installation on hot and cold line fittings a new molded insulation comes in preformed halves. It can be used on moderate low temperature work and on heated piping to 450 deg. F.

Insulation fits screwed and buttwelded fittings. The halves can be stapled, wired or taped together. Exterior surface can be canvas, vapor barrier mastic or cement.

Product is available in sizes to fit American Standard Cast Iron screwed ells, tees and 45's for ½ to 8 in. pipe; and for Standard Butt Welded Long Radius ells and 45's for 2 to 8 in. pipe sizes. Screwed tee insulation can be used on gate and globe valves.—Owens-Corning Fiberglas Corp., Toledo 1, Ohio.

292C

Titanium Alloy

Shows greater strength at normal and elevated temperatures.

A new titanium-base alloy C 130 AM is stronger than pure titanium. Containing 4 percent aluminum and 4 percent manganese this alloy is 85 percent stronger at room temperature and twice as strong at elevated temperatures.

In this particular combination aluminum and manganese contribute maximum strength yet retain maximum forgeability.

Tests already conducted on the alloy indicate it to have strength superior to steel and aluminum under conditions similar to those experienced by jet engine compressor wheels.—Rem-Cru Titanium, Inc., Henry W. Oliver Bldg., Pittsburgh 22, Pa. 292D

Nickel-Clad Plate

Made by electrodeposition offers economies.

Considerable economy over present types of rolled nickel-clad steels is offered by the Lectro-Clad plate. Using an electrodeposition method the thickness of the nickel can be tailored to the need; it is not controlled by the thickness of the base metal.

Plates up to 8 x 20 ft. are being clad with nickel deposits up to 0.020 in. thick. The layer of nickel is tenaciously bonded, ductile and pore-free. The clad plates will withstand heating, forming, bending and other fabricating processes without damage. All related welding techniques have been perfected and no special equipment is needed.—Bart Mfg. Co., Belleville, N. J. 292E

For More Information . . .



about any item in this department, circle its code number on the Reader Service

Postcard inside the back cover.



Vitro is a company engaged in engineering, development, processing and manufacturing. It is in the business of applying science and technology in new fields for both industry and government.







Most of Vitro's engineering achievements have, in the past, been national secrets. Now, however, it is known that Vitro has designed:

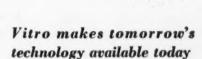
- the original uranium gaseous diffusion plants at Oak Ridge
- extensive plutonium facilities at Hanford
- the country's largest titanium plant
- the Chemical Corps' recently announced Nerve Gas Plant
- many other intricate processing facilities.







Among Vitro's other activities are research and development, especially in electronics, metallurgy and chemistry; the processing of uranium ore; the recovery of rare metals; and the manufacture of ceramic colors.





CORPORATION of AMERICA 261 Madison Avenue, New York 16, New York

DIVISIONS

VITRO MANUFACTURING COMPANY

Makes ceramic colors and pigments and related chemical products

VITRO URANIUM COMPANY

Processes uranium ores on the Colorado Plateau for the Atomic Energy Commission

VITRO RARE METALS COMPANY

Refines and recovers rare metals and processes uranium materials

VITRO LABORATORIES

Conducts chemical and physical research and develops processes and systems

VITRO ENGINEERING DIVISION

Designs and engineers processing and technical facilities and manages construction



Eye Shields

Attach to side of safety glasses to up protection.

Removable side shields now are available for use with safety spectacles of any size or shape. They extend the range of protection to the top, side and bottom sectors.

Molded of clear or green acetate, these side shields are easy to attach or remove because of positive, nickel-silver clip holders. If prescription safety spectacles are worn then the shields can be removed at the end of each day and replaced again in the morning. — Watchemoket Optical Co., 232 West Exchange St., Providence, R. I. 294A

Auxiliary Trailer

Carries extra fire and safety equipment to supplement that carried on fire truck.

Small trailer was designed as an auxiliary for the regular fire truck at Union Carbide & Carbon Company's Bakelite plant at Bound Brook, N. J. It gives ready mobility to essential equipment that cannot be accommodated on the big truck.

Double-opening doors across the full width of the trailer provide access to front and rear storage compartments Stored in these compartments are 2 Chemox gas masks, fire ax, 2 crow bars, 2 flood lights, 2 portable hand searchlights, a 1.5 kw. portable generator, a portable electric megaphone with its power unit and a floodlight.

A center-well fitted with top opening door serves as storage space for 8 all-purpose gas masks.

In addition to the towing attachment trailer has pull handles for manual movement.—Preakness Inc., 1060 Broad St., Newark 2, N. J. 294B

Respirator

Protects against toxic dusts as well as organic vapors.

A single respirator has been developed to protect the wearer against toxic dusts and organic vapors. Designated the Confo chemical cartridge respirator, it employs static-web dust filters which clamp on the respirator's twin chemical cartridge filters. Dust filter is made of charged resin-treated felt, thus dust is retained both by electrostatic action and mechanical filtration.

Respirator was developed for service in working areas where dust and vapor hazards are encountered simultaneously. Cartridges and filters for new respirator are independently replaceable, allowing greater economy in supplying parts.—Mine Safety Appliances Co., Braddock, Thomas & Meade Sts., Pittsburgh 8, Pa. 294C

Chemical Goggle

Overcomes fogging difficulty through application of natural draft ventilation.

Chemical operators wearing the Stac-Vent safety goggle gain complete protection against chemical splash and impact combined with freedom from fogging.

Warm moist air is removed from the goggle by a natural draft which leaves through a protected vent at the top of the goggle.

A soft vinyl frame yields to the contours of the face and nose. Replaceable lenses of optically-correct shatter-proof plastic are held in the frame by a positive lock bar.—Watchemoket Optical Co., 232 West Exchange St., Providence, R. I. 294D

Smoke Detector

Gives warning of unprotected condition in event of power failure.

A line of industrial smoke detection equipment has been modified to include a power failure alarm.

Multi-spaced smoke detectors are powered by 155-v. a.c. current. If power should fail the important job of smoke and fire detection halts.

With the new power failure alarm system the unprotected condition is revealed immediately. A 6-v. battery powered device causes an audible alarm to sound.

By throwing a manual switch from normal to bell silence, the alarm stops ringing and red light on the panel flashes, indicating the derangement. When normal power is restored and smoke detection continues, the red light goes out and the alarm bell rings again. It can be silenced by throwing the manual switch back to normal.—Walter Kidde & Co., Inc., Belleville 9, N. J. 294E



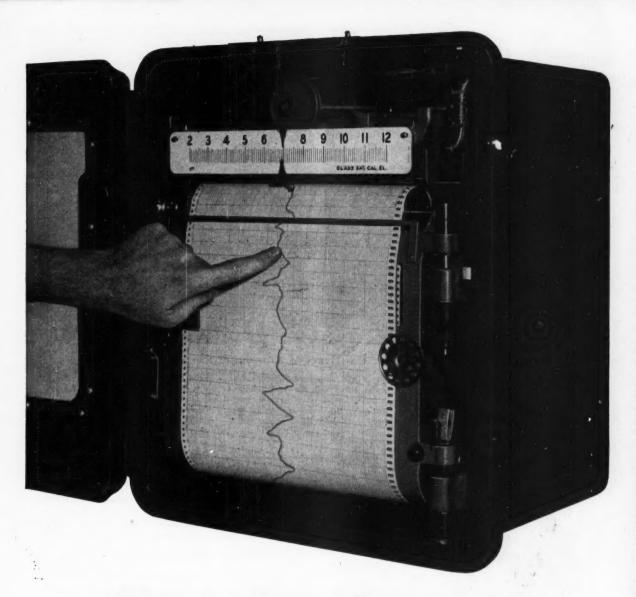
Radiation Detector

Easily fits into man's pocket, helps guard personnel.

Beta and gamma radiation sources are readily located with the new Norelco light-weight radiation detector. Weighting only 25 oz. the PW 4010 instrument measures only 1.7x4.1x6.6 in.

Detector can be used for X-ray monitoring, locating lost radioactive materials, guiding persons in contaminated areas, measuring radiation exposure of workers and checking intensity levels.

Special circuit in unit draws current from the anode batteries only when the geiger tube registers counts. The life of the anode battery is greatly prolonged by this feature.—North American Philips Co., Inc., Research & Control Instruments Div., Mount Vernon, N. Y.



This is the pH record

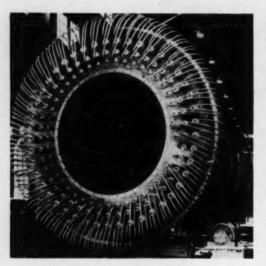
...being achieved by Speedomax® control on a plant waste treating process. It didn't just "happen". When we were called in, the pH value was roaming all over the map, in spite of the best efforts of an experienced process operator. But difficult as the problem was for the user, it gave way when attacked by our scientific analysis method.

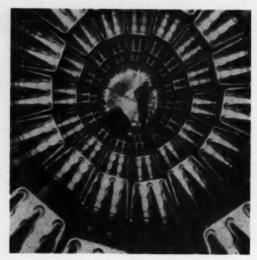
We asked the chemical engineer for specific information. Adequate facts were readily available, pertaining to the plant's raw waste, the layout and retention of the treating system, the characteristics of the neutralizing agent used. We applied our "Controllability Analysis"—proved by thousands of applications—and in less than half an hour, made our recommendations. The record speaks for itself.

The control results which we predict become actual results at your plant because complete pH equipments are a package, made and serviced by Leeds and Northrup. They include single and multiple point Speedomax recorders, pneumatic and electrical controls, highly pH-sensitive electrodes and newly designed electrode housings for practically any processing requirement.

For full particulars, send process data to Leeds and Northrup Company, 4916 Stenton Avenue, Philadelphia 44, Pennsylvania.



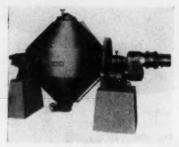




Giant Rotary Steam Tube Dryer Has Heart of Aluminum

Not only the heart but everything other than the exterior shell of this dryer is fabricated of aluminum. It's one of a group of the largest dryers of this type built to date, measures 10 ft. in dia. and 100 ft. long. Lin-

ing is 61S aluminum alloy plate. Steam tubes and the longitudinal extruded finned tubes used in one portion of the drying area are fabricated from 63S alloy. Aluminum castings support the pipe and tubes. Total heating surface in the 200 psig. steam tubes is 23,700 sq. ft.—Louisville Drying Machinery Unit, General American Transportation Corp., 139 South Fourth St., Louisville, Ky. 296A



Vacuum Dryer

Handles job with fraction of labor and maintenance needed by other types.

No, we didn't switch illustrations. Although this unit looks like a familiar double-cone blender it is actually a vacuum dryer. It is built in a double-cone form to give complete, fast heat transfer for drying temperature-sensitive or easily-oxidized materials.

As the dryer rotates individual particles in the charge are continually changing position with respect to each other. The action is one of free-falling, over-riding

and cascading without breakage or deformation of crystals. Also there is maximum contact of the particles with the heat transfer surface of the jacket.

It is a simple matter to apply vacuum to the Conaform dryer. If desired, condensers also can be applied. Speed variations can be included to permit blending operations prior to drying.—Patterson Foundry & Machine Co., East Liverpool, Ohio. 296B

Air Heater

Utilizes unique burner design to provide simple, compact unit.

Where combustion products can be mixed with the air being heated the Type CA heater offers simplicity and compactness. It is a low cost, easily adapted unit for use with ovens, drying kilns, spray dryers and similar process equipment.

Basic element is the Thermal High Velocity Burner (gas, oil or combination) that can substantially complete the burning within the burner body. Thus the heater is essentially a mixing chamber where combustion products are mixed with the air being heated.

Turbulence from the products of combustion, further increased by simple mixing baffles, mixes gas and air quickly and thoroughly with low pressure drop. Refractory normally is not used in the heater.

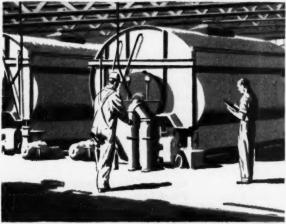
Heater dimensions are custom fitted to the individual job. Units for operation against high pressures are offered in the same simple design as those operated at atmospheric pressure.—Thermal Research & Engineering Corp., Conshohocken, Pa. 296C

For More Information . . .

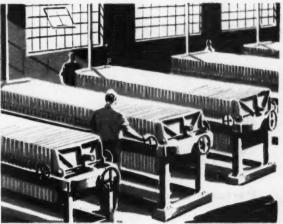


about any item in this department, circle its code number on the Reader Service

Postcard inside the back cover.



Cotton filter fabrics—widely used in beet sugar processing—are economical, durable, have high wet strength and good mechanical efficiency.

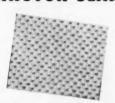


Acrylic type fibers when made up into filter fabrics are highly resistant to strong mineral acids under elevated temperature conditions such as used in certain dye filtration processes.

YOU GET EASIER CAKE DISCHARGE

WITH THIS WELLINGTON SEARS

FILTER FABRIC



Shown here in use is a press equipped with Wellington Sears filter fabric in a special construction of filament nylon, designed expressly for clay filtration. It is made to stand up under abrasion and flexing . . . and smooth enough for easy cake discharge.

Whatever your "tough problem" there's most likely a Wellington Sears fabric already in use—or one that we can develop—to solve it. There's the confidence in over a century of industrial fabric experience to back up that statement.

Wellington Sears cotton and synthetic filter fabrics are made available to the processing industries through leading filter cloth specialists. Write us for names of those serving your area.



Wellington Sears

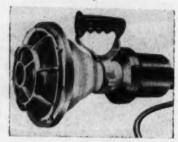
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FIRST In Fabrics For Industry

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NEW ELECTRICAL & MECHANICAL EQUIPMENT



Portable Floodlight

Has approval for use in all hazardous areas.

A new explosion-proof portable floodlight assures 100 percent safety in the lighting of all hazardous areas. It's said to be the only portable floodlight to receive the approval of the Underwriters' Laboratories, Inc. for such widespread use . . . and the only one permitted for use in hydrogen, acetylene and manufactured gas areas.

Dependability of the lamp rests on keeping interior air pressure in each fixture greater than the surrounding atmosphere. Thus entrance of any gas into the unit is prevented.

Lamp is fabricated of reinforced Formica plastic material that is first molded and then machined to extremely close tolerances.—Safe Lighting Inc., 91-03 Astoria Blvd., Jackson Hgts., N. Y. 298A

Storage Battery

Can be charged fully within 30 min. without damage.

Outstanding advantage of a new heavy duty battery is its ability to take a full charge repeatedly without damage in a matter of minutes. It is claimed to be the only battery to take a charge at the boiling point without deterioration.

Voltage is said to be 10 percent higher and to remain consistently high throughout 90 percent of operating discharge. More watt hours are obtained than with other batteries having the same amperehour rating.

Secret of the performance lies in the use of lead-hydrate plates. They feel like sponge yet will not shed, buckle, expand, sulfate, or deteriorate. Batteries are competitively priced and guaranteed for 6 years.—X-L-Ko Mfg. Co., North Vancouver, B. C. 298B

Weld Backing Rings

Made of ceramic are used for better, faster pipe welds.

By using ceramic backing rings, pipe welds can be made smooth and uniform with a slight concave shape that provides maximum strength and minimum flow resistance. Rings are easily removed when the weld is finished.

The new rings assure complete root penetration, prevent icicles and weld splatter. Proper root penetration on every joint reduces test failures, speeds welding operations and lowers cost of fabrication.—Chemical Equipment Div., General Ceramics Corp., Keasbey, N. J.



Catalytic Muffler

Reduces noxious, irritating components of diesel exhaust.

Through use of the Dieseler catalytic muffler the harmful and unpleasant effects of diesel exhaust are largely overcome. Unit eliminates 65-85 percent of the irritating hydrocarbons and 80-90 percent of the carbon monoxide.

Unit shown atop a tractor-shovel is a twin-flow, heavy-gage steel assembly containing eight catalytic sections. Over-all dimensions are 7 by 12 by 27 in.

Each catalytic unit is a compact porcelain structure containing 73 slender porcelain rods coated with alumina and platinum alloy. Hot engine gases flowing across these rods are catalytically burned to carbon dioxide and water vapor.—Oxy-Catalyst, Inc., Wayne, Pa. 298D

Solvent-Resistant Packing

Designed for use with non-water soluble solvents.

Two new mechanical rod packings can be used when handling materials such as benzene, carbon tetrachloride, xylene, turpentine, kerosene, gasoline and Stoddard solvents. While costing about the same as competitive packings they have longer life.

The packings incorporate an entirely new lubricant impregnated by a new process. Style No. 181 has a square braided rayon base and is used for pumps, valves and fittings handling material up to 200 deg. F. For temperatures above 200 deg. F. Style No. 1024 is recommended. This material has a high-grade, braid-over-braid white asbestos base.—Flexrock Co., Packing Div., 3605 Filbert St., Philadelphia 1, Pa. 298E

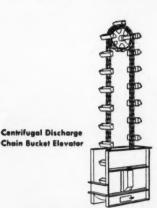
Bearing Compound

Works well as bearing surface in presence of corrosives.

Compounded of Teflon, glass, graphite and an inert lubricant Style FM-4 bearing compound is suitable for corrosive service. Being hard with a low friction coefficient it makes a good bearing material.

Bushings and bearings made of FM-4 can be machined to close tolerances. For wearability they compare favorably with metal bearings and bushings. At both normal and elevated temperatures they can withstand strong acids and solvents.

Style FM-4 material can be furnished as finished bearings and bushings or in the form of rod, tube and cylindrical shapes.—Chemical & Power Products, Inc., 11 Broadway, New York 9, N. Y. 298F



WHICH



Centrifugal Discharge Belt Bucket Elevator

BUCKET

IS

Positive Discharge Bucket Elevator

RIGHT

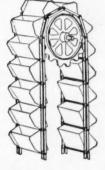


FOR

Continuous Bucket Elevator

YOU?

Super-capacity Bucket Elevator



ELEVATOR

Which type will best fit your requirements... should buckets be chain or belt mounted... should the unit be inclined or vertical?

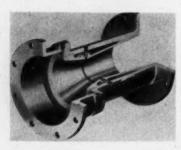
The answer is relatively easy, but it takes an expert to select the one type of bucket elevator and the proper specifications for it that will do the most efficient job for you... at the lowest over-all cost. The type of material to be handled, weight of material, number of operating hours per day, space and capacity requirements... all these factors enter into the proper selection and application of a bucket elevator. So, for your bucket elevator needs, why not do as so many other companies do ... refer your problem to "bucket elevator headquarters"... CHAIN Belt Company.

The experience of more than half a century... the correct engineering that delivers full rated capacity, full production for your plant... the balanced bucket elevator design assured because Chain Belt designs and makes all its own bucket elevator parts... are yours from Chain Belt Company. For complete facts, write Chain Belt Company, 4648 W. Greenfield Ave., Milwaukee 1, Wis.

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To get best results from your conveyor and bucket elevator, feed them right...not too little...not too much...but just right with Rex® Apron Feeders.



Flow Tube

Measures flow rate while holding head loss to minimum.

Liquids and gases carrying no settleable solids can be metered using the Dall Flow Tube. Outstanding advantages include lowest permanent head loss of any known differential producer of the velocity increaser type, short length, low weight and low cost.

Tube has a short, flanged, cylindrical body designed with an abrupt decrease in diameter, followed by a conical restriction and diverging outlet.

Reduced area at the cone en-

trance and the design of the annular throat induces a high differential pressure. The diverging cone outlet provides high recovery of differential pressure.

The tube is constructed with a Mechanite iron body and precision-machined bronze throat liner.—B-I-F Industries, Inc., 345 Harris Ave., Providence, R. I. 300A

Diaphragm Seal

Isolates instrument from system pressure, permits servicing without releasing pressure.

A new continuous duty diaphragm seal isolates instruments from the pressure system, gives protection against clogging and corrosion. Also it permits instrument to be serviced or changed under pressure without disturbing production. It is used with any bourdon-tube pressure instrument or in some cases bellows type where total maximum displacement does not exceed 0.2 cu. in.

Installed at the instrument tap on the pressure system these diaphragm seals serve as a barrier between process fluid and the instrument. All the space above the diaphragm including the internal space of the instrument is filled with a liquid. That liquid transmits process pressure to the instrument element.

· Models are available for pipe or flange mounting. All seals except those for over-range protection can be furnished to operate up to 500 deg. F.

A union connection permits the instrument to be removed under pressure. Within the union an integral piston displaces the filling liquids as the connection is made. This action moves the diaphragm away from the machined shape that serves as a limiting stop.—Mansfield & Green, 1051 Power Ave., Cleveland 14, Ohio. 300C

Portable gas detector measures minute quantities of gas in air. Based on the absorption of ultraviolet light the unit will detect only a few parts per billion which is less than one-twentieth the toxic concentration for many substances. — Manufacturers Engineering & Equipment Corp., Hatboro, Pa. 300D

Super-sensitive gas analyzer is capable of indicating gas concentrations as low as 5 parts per billion. Unit uses sensitive method based on the detection of mercury vapor in ultra-violet light.—Taller & Cooper, Inc., 75 Front St., Brooklyn 1, N. Y. 300E

Radiation detector locates sources of alpha contamination in clothing. When alpha Poppy detector is passed over contaminated area either an audible popping noise or a visual signal is produced. Alpha rays pass through thin aluminum foil which excludes light. These alpha rays are caught by a zinc sulfide screen which converts their energy to create light. The light is converted to electrical impulses.—General Electric Co., Schenectady 5, N. Y. 300F

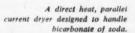


Checking Meter in New Testing Station

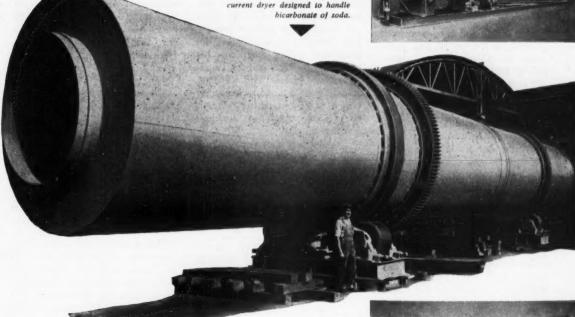
Engineer checks performance of 500 gpm. meter on 4-in. test line at new Rockwell meter and valve testing station. Complete facilities have been erected to permit testing under actual field conditions. Range of materials that can be handled

covers oil and gasoline, water, chemicals, beverages, liquefied petroleum gas and other fluid products. Every precaution has been taken to protect the installation from fire.—Rockwell Mfg. Co., 400 North Lexington Ave., Pittsburgh 8, Pa. 300B

Steam tube dryer. Enables continuous operation at uniform temperature, producing an extremely uniform product.







"LOW OPERATING COST" WITH

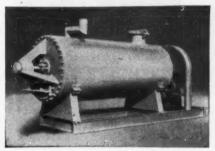
RD HERSEY

Presque Isle Starch Company of Maine reports potato starch drying production doubled...Huron Milling Company of Michigan reports one STANDARD-HERSEY dryer replaces 16 pairs of hot rolls... Stansbury Salt Company of Utah reports high efficiency at very low operating cost... Warriner Products Company of Louisiana reports very satisfactory operation in dehydrating sweet potatoes.

Hundreds of similar comments add up to one thing-STANDARD-HERSEY dryers are cutting costs and increasing production in many phases of the food field. We have, or can find, a solution to your drying problem. More than 30 different types of STANDARD-HERSEY dryers are available. Over 4,000 dryers have been built for hundreds of product applications. Investigate STANDARD-HERSEY for the answer to your drying problems.



Intermediate feed type starch dryer. Dries product from 40% to 18% with hourly output of 1,500 lbs. Extra high thermal efficiency because of no boiler



Steam jacketed batch type. May be used as either a dryer or cooker – operated under pressure or vacuum. Available with alloy or stainless interior.

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THE STANDARD FOR 52 YEARS

Corrugated Container

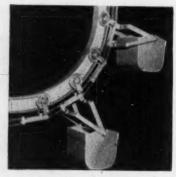
Holds 1,000 lb. of plastic pellets, cuts package cost.

Corrugated fiber containers have grabbed off the job of bulk packaging for Dow's Styron plastic pellets. Economies are claimed in initial package costs, storage and material handling.

Holding 1,000 lb. the octagonal box measures 33 in. across flats by 41½ in. high. It consists of an inner body, the bottom lid into which the inner body slips, the outer body which telescopes over the bottom lid and the inner body, and the top lid which fits over outer body.

Lids and bodies arrive from the box factory in "knocked down" condition. After assembly they are palletized prior to filling, placed under the delivery chute, filled and carried away by a fork-lift truck. Previously, handling the same amount of material required 5 drums to be filled and palletized after leaving the delivery chute.

When the box is filled and capped, it is steel strapped in two directions to an expendable wooden skid.—Gaylord Container Corp., 111 North Fourth St., St. Louis 2, Mo.



Bucket Conveyor

Has patented hanger to keep bucket upright.

Lower conveying costs are claimed for a new type bucket trolley conveyor with patented "Stif-Arm" bucket hanger design. Conveyor trolley consists of a single I-beam. A universal-type chain runs paralled to the I-beam with standard roller attachments.

Unique feature is a second "Stif-Arm" bracket brace to hold the bucket trunnions at a fixed distance away from the trolley chain and beam. This prevents buckets from swinging loosely against the chain and spilling their contents while making the vertical or inverted runs. Instead, buckets rotate around their trunnions remaining upright at all times until they reach the tipping rollers at discharge points.

The fact that buckets remain upright permits a multiple-plane path with a single conveyor thereby eliminating the cost of numerous transfer points. A single drive unit operates the conveyor; separate drives are not needed for each plane of operation.

Buckets are self-loading and unloading for handling bulk materials automatically.—Hapman Conveyors, Inc., Kalamazoo, Mich. 302B



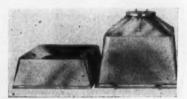
Acid Wagon

Brings increased safety to handling of corrosives.

This completely mobile Acid Buggy facilitates quick, simple transfer of corrosive materials from bulk tanks and carriers. It eliminates waste and prevents damage caused by spillage.

Model XB-425 shown above has a capacity of better than 400 gal. Rubber covering protects both the interior and exterior of the tank. Construction meets ASME code for operation at 40 lb. pressure.

Wagon is fitted with Saunders type rubber-lined valves. Other items included are tow bar, axles, wheels, tires, four 50 ft. lengths of acid hose with nozzles, overflow funnel, gage glass and fittings, pneumatic controls, air filters, air gage, gage board and 75 ft. of air hose.—Automotive Rubber Co., Inc., 12550 Beach Rd. at P.M.R.R., Detroit 28, Mich.



Shipping Containers

For wide range of materials nest like cups when empty.

When empty, Nesta-Bin airtight aluminum shipping containers can be taken apart in seconds and nested into each other like paper cups. Thus, 10 truckloads of full Nesta-Bins can be returned empty on one truck.

These containers are designed for the shipment of liquids, powders, pastes or granular substances. They can be furnished with rubber or plastic linings on special order.

Bins are made with identical half sections which are joined by means of cam fasteners to form an airtight seal. Airtight doors are located in each end.

The assembled bin rests on a base. Contents can be dispensed from the bottom door through a gate valve, valve fitting or hand-operated screw conveyor.

Three basic models are available: rectangular type with 58 and 70 cu. ft. capacities and a round type with 42 cu. ft. capacity.

Selling price will range from \$275 to \$305 according to the size and quantity purchased.—Nesta-Bin Co., Denver, Colo. 302D

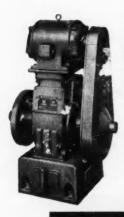
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Postcard inside the back cover.

Cut Costs... Boost Efficiency...with Stokes High Vacuum Pumps



At left is the new Model G Stokes High Vacuum Pump. Basically, and in autward appearance, the new model is the same simple, efficient, compact and reliable unit as its widely used predecessor, Model F. Five major engineering improvements are incorporated in the new model: 1) a new mechanical face-seal minimizes routine maintenance and reduces to a minimum the possibility of oil leakage at the shaft; 2) new exhaust valve-stops permit use of these pumps in an exceptionally broad range of applications, including rapid cycling evacuation of large-valume systems; 3) a new intake screen filter prevents damage by dirt, scale, and other solids sometimes present in the system; 4) a new oil filter in the line to the shaft seal affords special protection to the bearings at these points; 5) a new solenoid valve in the oil supply line automatically prevents oil-flooding of the pump in the event of power failure.

Simplicity and sturdy construction, accessibility, high volumetric efficiency, low power consumption, and effective cooling are distinctive features of Stokes High Vacuum Pumps.

Better blank-off pressures and quieter operation are assured with a completely new, longer lasting exhaust valve assembly. Intake ports are open during the entire intake cycle; there is no slide-valve shut-off.

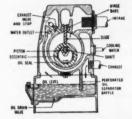
Lubrication is completely automatic. There are no oil shut-off valves and adjustments. Horizontal vacuum intake permits trapping of harmful dirt and scale. Vacuum-tight rotary seals eliminate the need for shaft packing and constant adjustment. Easy access is provided to the valve assembly and other parts requiring periodic examination.

Stokes High Vacuum Pumps are available in capacities from 15 to 500 cfm. Where necessary, oil purification units — to assure continuous supply of clean, water-free oil — can also be furnished.

Wherever hard, continuous service is required to meet today's exacting high vacuum requirements, Stokes High Vacuum Pumps prove a profitable investment.

Consult with Stokes on the application of vacuum to drying, freeze-drying, impregnation, extraction, solvent recovery, evaporation, vacuum metallizing, and to other purposes for which vacuum deserves exploration,

F. J. STOKES MACHINE COMPANY PHILADELPHIA 20, PA.



The operating principles of the Stokes High Vacuum Pump are simple. Rotation of the Stokes Pump is indicated in cross-section view at left: Air enters the increasing space at right of piston, while air trapped in the decreasing space at left of piston is compressed. As piston nears top of stroke, pressure of the trapped air opens the feather-type discharge valve against atmospheric pressure, and the air is forced out of the cylinder. As piston posses through its top position, the suction port is momentarily closed by piston. Air then present in cylinder is trapped, a new cycle begins.



A completely revised brochure on Stokes High Vacuum Pumps is now available, free, upon request. It explains, and shows, how Stokes Pumps combine simplicity of design, high valumetric efficiency and lowest operating costs to provide reliable, continuous service for all kinds of high vacuum processing equipment. Examples of typical vacuum systems using Stokes Pumps are cited and typical problems in pump selection and their solution are provided. Also described is the complete line of Stokes High Vacuum Processing Equipment and the new Stokes Experimental and Applications Laboratory in Philadelphia, Penna.



The new Stokes Vacuum Calculator for rapid slide-rule vacuum calculations, including a standard ABCD log scale, is now available, free, upon request. It has proved to be of tremendous value to those engaged in vacuum research and processing. Simplifies determination of pump capacity required for given volume in given time or given volume to specified vacuum with user's present equipment. Numerous tables on reverse face provide useful vacuum reference data.



Send for copy of a new handbook "How to Care for Your Vacuum Pump." (Bulletin No. 755). Contains many valuable sugestions about installation, starting, servicing, trouble-shooting; and helpful "Do's" and "Dont's" on vacuum pumps and vacuum pumping systems.



STOKES MAKES: High Vacuum Equipment, Vacuum Pumps and Gages/Industrial Tabletting, Powder Metal and Plastics Molding Presses/Pharmaceutical Equipment

GUIDED TOUR CONTINUED

PICTURED FLOWSHEET



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Two keys to a new process.

Solvent extraction and a horizontal filter: These are keys to a new process for refining cotton-seed oil. Here's the picture of how and why. (p. 324)



New data on private research.

Chemical firms spend 70% of their research money on new products and "basic" problems. That explains a lot more than first meets the eye. (p. 331)



Engineer takes over Army!

Well, not quite. But one chemical engineer—man-of-month Charles Bolte—is now second in command. Sherman also helped. (p. 344)

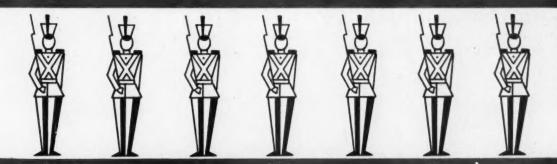


New technical literature . . .

You can now get—free and fast—literature on any subject in your field. Use our new enlarged section to keep your technical files up-to-date. (p. 412)



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... Another Big Advantage of WELDCO*Welded* TUBING

When you order WELDCO Tubing, you're sure to get complete uniformity throughout—uniform wall thickness, uniform weight, uniform I.D. and O.D., uniform close grain structure, and uniform workability. These are some of the important advantages of welded tubing, and they guarantee you a dependable product . . . tubing that has excellent fabricating qualities . . . tubing that's easy to bend, form, weld and assemble.

Remember, too—only WELDCO Tubing is welded with the exclusive Double-Fusion Process. It's available in Stainless Steel, Monel, Hastelloy, Inconel, Nickel, and Cupro-Nickel, in tube and pipe sizes from 3" to 30", Schedules 5 and 10, and 3" to 12", Schedule 40. For special problems, or regular appli-

cations, always specify WELDCO—your best buy in top-quality, uniform tubing!

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SELF-SHIELDING MECHANISM...

A-C AND D-C MODELS

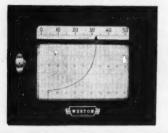
Employing the Weston CORMAG mechanism, this new recorder combines a high degree of shielding with new compactness and light weight. For example, the magnetic field created by a conductor carrying 15,000 amperes at a distance of 3 feet would cause a temporary error of less than 1 per cent. Over-all size is only 6¾" x 6¼" x 7" deep; chart size 4" dia.; weight only 1½ lbs.

It's the ideal instrument for recording ampere-hour demand—checking overloads or unbalanced conditions—monitoring radio detectors—recording current and duration in electroplating and metal refining—recording speeds—making life tests on batteries, lamps, etc.

Available in required ranges for A-C or D-C voltage or current measurement needs. Also furnished with bracket for wall mounting; and with flange case for flush panel mounting. Bulletin available giving complete specifications and prices . . . WESTON Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, New Jersey.

WESTON SIMPLIFIED RECORDING POTENTIOMETER

Sets a new standard for sound, simplified design—for simplicity and economy of maintenance—for sustained high accuracy and dependability. Ranges changed simply by inserting required range standards. Chart speeds changed by simple screwdriver adjustment. All features described in bulletin. Send for your copy.



WESTON Instruments

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Our warehouses stock an exceptionally large variety of tubing products . . . in fact, no less than 531 sizes of Shelby Seamless Mechanical Tubing are readily available! So you can always count on quick delivery of exactly the type and size tubing you need . . . whether your order is by the inch or by the carload. And all our tubing products are made by the world's lead-

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And, our extensive experience with tubing problems has often led to customer savings. For in many cases, our engineers can suggest a more economical type of tubing for your application.

Contact our nearest warehouse the next time you need quality tubing of any sort and in any quantity from our stock or directly from the mill: mechanical tubing, round and square, seamless and welded; boiler tubing, pressure tubing and pipe; and stainless steel tubing and pipe, seamless and welded.

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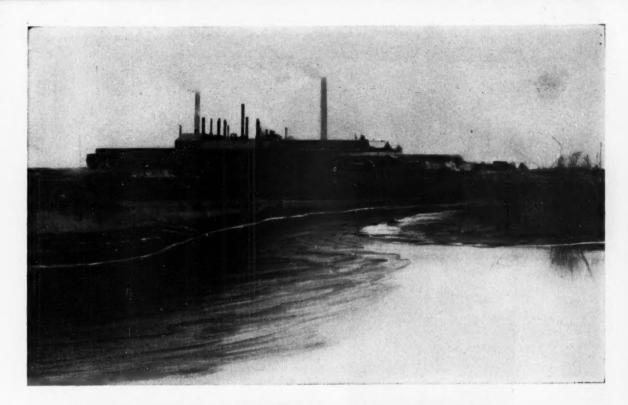
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Western Sales Representative:

B. M. Pilhashy, 833 Merchants Exchange Bldg., San Francisco 4, California DO 2-0375



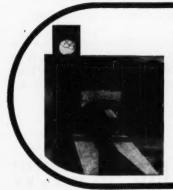
WORRIED ABOUT WASTE DISPOSAL?

Bailey Meters Help you to Reduce Pollution

 The disposal of industrial wastes without stream pollution calls for careful planning and continuous vigilance.

That's where Bailey Meters and Controls come in. We measure the flow and pH of sewage, sludge, and industrial wastes flowing in open channels or pipe lines. These and other factors, such as levels, rates of chemical feed, and flow of air, may be co-ordinated into a completely automatic system for the treatment and disposal of waste materials.

When you want fast, complete and authoritative answers to the measurement and control aspects of your waste disposal problems, reach for your phone and call your local Bailey Engineer. Offices in all principal industrial centers.



BAILEY OPEN CHANNEL METERS

These indicating, recording and integrating meters are suitable for measuring industrial wastes, sewage, sludge, corrosive liquids, and irrigation water flowing in all types of open channel primary metering devices, such as Venturi flumes, weirs, or nozzle flumes. Electric or pneumatic telemetering permits location of receivers wherever desired. Ratio of flows and chemical feeds may be controlled automatically.



1050 IVANHOE ROAD CLEVELAND 10, OHIO

Process Controls TEMPERATURE : FLOW PRESSURE : LEVEL GAS ANALYSIS : RATIO

P-24



mildly corrosive service

3% Nickel Iron Gate Valve, Class 125 lb.... for process industries... developed and produced by The Lunkenheimer Co., Cincinnati 14, Ohio. Outside screw and yoke, bolted bonnet, flanged... face to face dimensions are American Standard for 125 lb. Cast Iron Wedge Gate Valves (ASA B16.10-1939).

LUNKENHEIMER develops new 125 lb. nickel-iron valve for process industries...

Mildly corrosive valve service poses a particularly tough problem in the process industries. To get maximum corrosion resistance, you have to pay for more than you need—high-alloy valves are expensive. And yet, ordinary cast iron often won't do the job.

An economical answer to many of these problems has been developed by Lunkenheimer with this new line of Nickel-Iron Gate Valves. Bodies and bonnets are 3% Nickel-Iron, for better corrosion resistance than ordinary cast iron, and trim is offered in choice of 18-8 (Type 316) Stainless Steel or Monel®, for maximum resistance at the point of

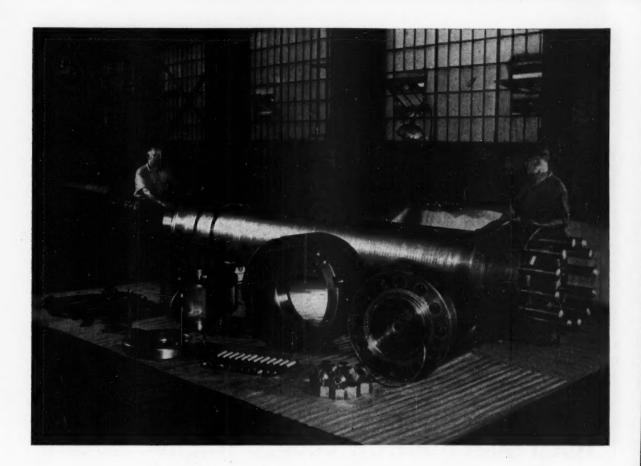
most severe service. This combination is cutting valve costs in the petroleum field, pulp and paper, wood treating, and scores of other process industries.

This development is but one more instance that shows how nickel alloys can be used to provide significant advantages, whatever the equipment.

Many standard nickel alloyed compositions are available, making it easy to select one with extra qualities for almost any specific use. Whatever your industry, if you have a metal problem, send us details for our suggestions. Write today.



THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET, NEW YORK 5, N.Y.



There's Some Pretty Fine Machining in This Forged Pressure Vessel

Like many others, this 14½-ton converter was made entirely in the Bethlehem shops. Starting as nothing more than a blueprint, it gradually shaped up as the steel ingot was forged, and finally became a pressure vessel after elaborate machining.

That's a point we'd like to emphasize—machining. It took some pretty detailed and careful work to do the job shown here. But requirements were met in full, just as they're always met before we release a vessel. Bethlehem's expert machinists handle many such assignments during the course of a year.

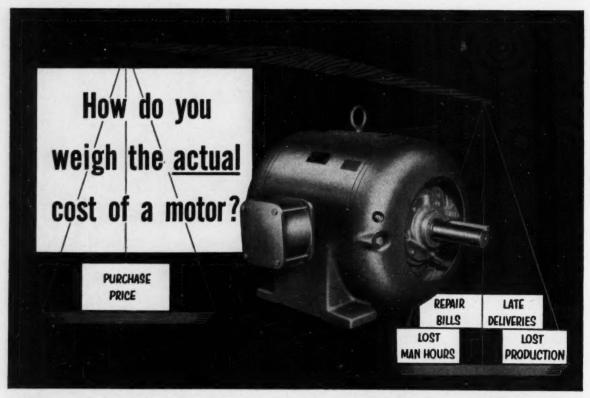
After finish-machining and subsequent assembly, the vessel had an overall length of slightly more than 20 ft. The shell itself was approximately 17 ft long. The unit was hydrotested to a pressure in excess of 10,000 psi.

Whenever your needs call for pressure vessels . . . autoclaves, filters, reactors, converters, separators, high-pressure accumulators, etc. . . . you can safely entrust them to our hands. We forge seamless vessels of practically every size and type, and of course machining is done exactly as you order it. Why not call us the next time you plan to discuss new units? We'll co-operate in every way.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast
Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation





Keep costs down...choose Wagner Motors

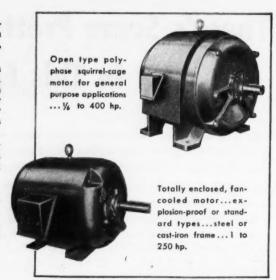
The selection of the right motor for every specific industrial application is all important. Due consideration must be given to motor type, rating, slip, torque values, and other operating characteristics.

But, because the ultimate cost is the actual cost of a motor... alert buyers look beyond such specifications. They look for other factors, such as cool operation, with consequent longer insulation life... and they consider the time-tested proven dependability of the brand of motor they specify. They know that it's costly to take chances with motor drives.

Wagner Motors have been proving their reliability for more than sixty years. Many thousands of users throughout industry have found them a lasting investment in continuous troublefree performance.

The wide range of types and sizes in Wagner's complete line permits the selection of a standard motor for almost any need. Bulletin MU-185 gives full information.

Your nearby Wagner engineer will be glad to help you select the *right* motors for your next application. Call the nearest of our 32 branch offices, or write us.





WAGNER ELECTRIC CORPORATION
6407 PLYMOUTH AVE., ST. LOUIS 14, MO., U.S.A.

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

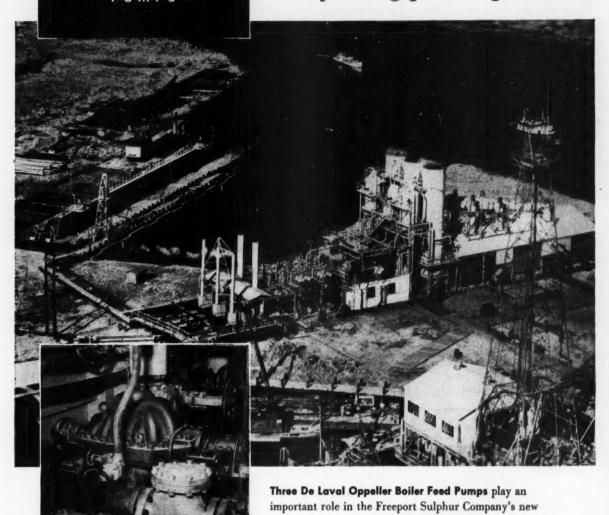
ELECTRIC MOTORS
TRANSFORMERS
INDUSTRIAL BRAKES
AUTOMOTIVE
BRAKE SYSTEMS—

AIR AND HYDRAULIC

DE LAVAL

OPPELLER PUMPS

are used for boiler feed on floating process plant



The De Laval Boiler Feed Pumps operate at 3,500 rpm with water heated to 297F. They are built with 12% chrome steel impellers and trim. The dependable performance of these units has led Freeport Sulphur to purchase six additional pumps for boiler feed service at two other mines. In addition to boiler feed, De Laval

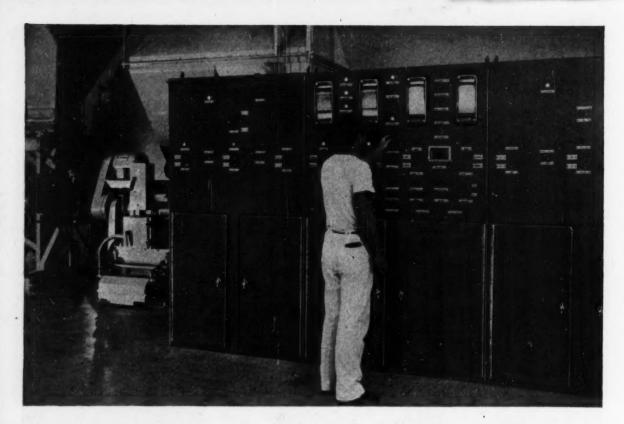
Oppeller Pumps are used throughout industry for mine dewatering, descaling, desuperheater feed as well as for services in the petroleum, pipeline and marine fields. Capacities range up to 2,000 gpm, pressures to 1,200 psig, temperatures to 350F; materials to suit any service. For complete data, send for Catalog 1502.



process which mines sulphur from a deposit beneath the Gulf of Mexico. This floating plant is located in the

marshes in Bay Ste. Elaine, Louisiana.

803 Nottingham Way, Trenton 2, New Jersey



RICHARDSON PROPORTIONING EQUIPMENT WORKS FOR Johnson Johnson

PROBLEM:

To insure invariably accurate proportioning of ingredients, proper timing of mixing, and efficient conveying of meterials for the production of baby and prickly heat powder at Johnson's Baby Products Plant at Crenford, N. J.

SOLUTION:

Richardson engineered and supplied automatic scales with a master control panel which coordinated the operation of the scales, the existing conveyers, mixers and sifters. Result: A consistently uniform product for the filling machines. A product like baby powder or prickly heat powder must be uniform—always. High customer acceptance depends on a product whose texture and composition remains the same month after month, year after year—the result of accurate blending. Making a profit or taking a loss because of high operating cost depends on rapid and accurate blending. That's why Johnson & Johnson called in Richardson to engineer a feeder—weigher—mixer system that would be fast—automatic—and ACCURATE.

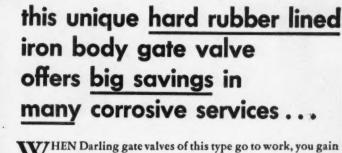
Richardson has specialized in engineering and building systems for materials handling by weight for more than half a century. Through these years a tremendous backlog of practical experience has been built up. As a result, we maintain... and have proved time and again... that there's no problem in pre-weighing, proportioning and mixing materials that can't be solved efficiently and economically... that the uniformity of any end product can be consistently maintained without need for heavy capital investment. Why not ask a Richardson engineer to survey your plant and submit suggestions? To do so puts you under no obligation and may pave the way to increased production and profits at lower operating costs.

Richardson Scale Co., Clifton, New Jersey. Feeder—Weigher Systems of All Types: Automatic Bulk Weighing Hopper Scales, Including Conveyor-Feed Types—Continuous Feeder-Weighers—Automatic Bagging Scales—Bag-Sewing Conveyors—Packers—Process Control Panels. Branch offices in: Atlanta · Boston · Buffalo · Chicago · Detroit Houston · Memphis · Minneapolis · New York · Omaha · Philadelphia · Pittsburgh · San Francisco · Wichita · Montreal · Toronto San Juan · Havana · Mexico City.





CORROSIVE FLUIDS?



multiple advantages sure to save you money and time.

First, you gain big initial savings because these rubber lined iron body gate valves (ideal for many corrosive services not exceeding 180° F.) are much less expensive than special alloy valves. Moreover, Darling's special bonding technique permanently prevents separation of the hard rubber lining from the valve body.

All interior working parts are made of alloys suitable for the corrosive conditions encountered.

Secondly, and equally attractive, is Darling's exclusive fully revolving double disc, parallel seat feature! In a nutshell this means drop-tight closure where most other valves would fail. It also assures unmatched life with a very minimum of attention and maintenance.

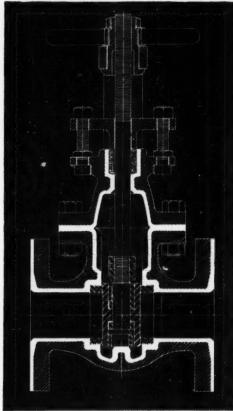
Here's a combination you just can't beat! Before you buy gate valves of any type, get acquainted with these unique Darling valves and their operating details. Get all the facts.

Write today for free bulletin describing Darling rubber lined gate and check valves.

DARLING VALVE & MANUFACTURING CO.

Williamsport 3, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario



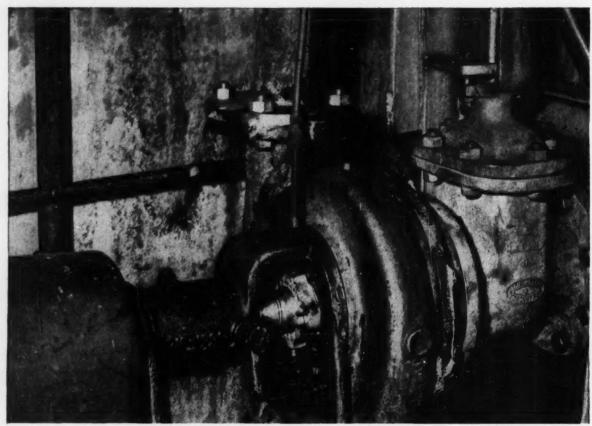
Darling 150-pound rubber lined gate valve, with outside screw and yoke, featuring unique parallel seat, fully revolving disc principle. Plain "no pocket" discs prevent accumulation of sediment. Darling rubber lined gate valves can be furnished only in rising stem, cylinder or motor operated; or quick-opening types.

DARLING VALVES FOR EVERY NEED

Darling parallel seat revolving disc gate valves are available in a wide range of sizes and constructions for all kinds of normal and unusual service, and for pressures up to 1500 pounds. In addition to rubber lined, iron bod valves, corrosion resistant types include plain iron body with special alloy trim, cast steel, all bronze, special alloys or combinations as required. We'll gladly furnish specific recommendations on the proper valves for your particular service.



FOR PLUS VALUES, JOB-PROVED AGAIN AND



WORTHITE CHEMICAL PUMP WITH MECHANICAL SEAL handles hot copper sulphate solution used by Scovill Manufacturing Co., for pickling brass. Note water connection for preventing formation of crystals.

Mechanical seal on Worthite pump needs no repairs after 3 years' corrosive service

Over 3000 Worthington installations prove its effectiveness

The ability of Worthington mechanical seals to handle corrosive liquids has been firmly established by thousands of actual installations.

In many applications where leakage or packing is a problem, mechanical seals have proven themselves to be the answer. If the pump is changed to a service requiring packing, a simple adapter can be installed and packed in the normal manner.

Worthington can supply either a mechanical seal or conventional stuffing box as standard pump equipment — with both readily available from stock. This, plus our experience with over 3000 successful mechanical seal installations, enables us to advise our customers which is the best type of seal or stuffing box for each specific application.

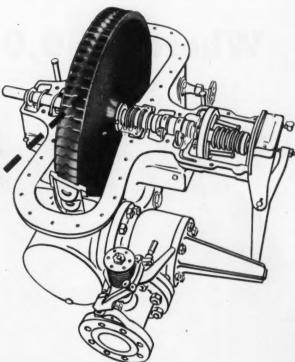
Write for bulletin W-350-B16, Mechanical Seals for Worthite Chemical Pumps, to your nearest Worthington district office. Or write to Worthington Corporation, Centrifugal Pump Division, Section C.3.8, Harrison, New Jersey.

WORTHINGTON



Type CNG Worthite Chemical Pump Sizes ¼ to 6". Capacities to 2000 gpm; heads to 200 ft. Type CNP Haveg Chemical Pump Size 1½". Capacities to 160 gpm; heads to 70 ft. Type KEB Worthite Propellor Pump Sizes 8 to 24". Capacities to 19,500 gpm; heads to 20 ft.

TERRY SOLID WHEEL



..."trade mark" of a trouble-free turbine

This is the rotor of a Terry solidwheel turbine. There are a number of reasons why it has become a symbol for reliable, trouble-free operation.

First, because the wheel is a single forging, in which a series of semicircular buckets is milled, there are no separate parts to become loose or work out.

Second, because the power-producing action of the steam takes place on the curved surfaces at the back of the buckets, blade wear is of little consequence. Wear does not materially affect horsepower or efficiency.

Third, because the steam enters the buckets in a direction at right angles to the shaft, there is no need for close axial blade clearances. The blades cannot foul. There is a one inch clearance on either side of the wheel. In addition, the blades are double rim protected.

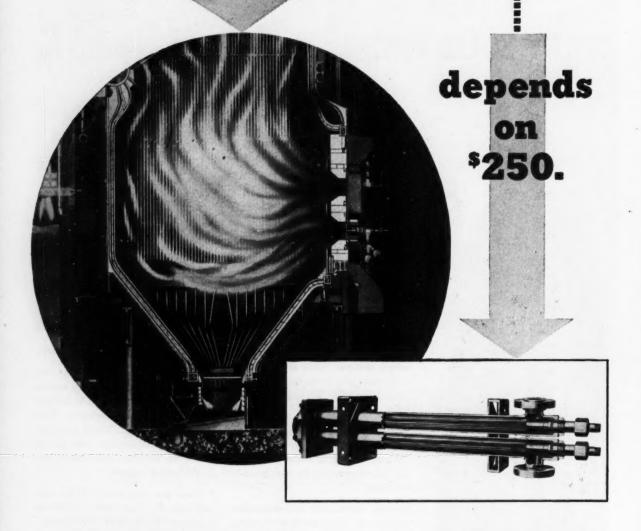
These are only a few of the reasons why the Terry solid wheel has become a "Trade Mark" for trouble-free turbine performance. For complete details, send for a copy of bulletin S-116. No cost or obligation.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.



CHEMICAL ENGINEERING-July 1954

Where \$250,000..



Many large-capacity high-pressure oil-burning boilers cost as much as a quarter of a million dollars; while the little fuel oil heaters that serve them cost only a few hundred dollars. But these huge boilers can deliver the desired steam only if the little heaters maintain rated capacity and preheat the fuel oil sufficiently to assure free flow.

G-R Fuel Oil Heaters will give your boilers . . .

and you . . . this assurance. Their reliable ratings are based on the G-R 85 years of experience in heat transfer. Their simple design and their sturdy construction, conforming to API-ASME codes, assure dependable operation. They are easy to clean and economical to maintain.

For fuel oil heaters with these important features, investigate the G-R Line.

THE GRISCOM-RUSSELL CO. . MASSILLON, OHIO



Fuel Oil Heater



GR-32

Simple and RUGGED...

CHAPMAN'S MOTOR UNIT

for Valves, Floorstands
and Sluice Gates



Simple, durable mechanism of Chapman's Motor Unit. Handwheel remains stationary during motor operation.

Floorstand equipped with Motor Unit . . . control panel, motor, limit switch and push button station.

Chapman Motor Units have fewer components than any other units, providing greater dependability, much lower maintenance costs.

There are only two pinions and two gears in the motor reduction train: drift is eliminated and lash is negligible. Your valves seat tight, but not too tight. Operation is *always* smooth and trouble-free.

You can mount the Chapman Motor Unit in any position, at any angle required. The rugged stub-tooth gears require no grease or oil bath . . . yet run smoothly, quietly, with minimum wear.

Weatherproof and steam tight, Chapman's floorstand units are shipped completely wired, ready to connect to your power leads, for easy, rapid installation. This modern motor unit is dependable and economical. Send for new catalog No. 51.

The CHAPMAN Valve
Manufacturing Company
INDIAN ORCHARD, MASSACHUSETTS

Engineers - here's how a Speedline system will cut your piping costs!

on pressure problems

If You Use Schedule 40 Pipe at 150 psi Operating Pressure



Schedule 40: 100 to 1 Safety Factor

Lighter Wall will Meet Pressure Safety Requirements



Schedule 10: 83 to 1 Safety Factor



Schedule 5: 50 to 1 Safety Factor

BUY ALL THE WALL YOU NEED . . . DON'T BUY MORE

on flow problems

If You Use Screwed Fittings



You Lose One Half The Wall You Bought—AT THE THREADS

Lighter Wall Plus Speedline Fittings Give You:

GREATER INSIDE AREA · MORE FLOW LOWER PRESSURE DROP







You get greater flow and capacity in light-wall pipe. For example, Schedule 5 has 15% to 25% more capacity than Schedule 40.

on corrosion problems

CORRECT ANALYSIS will combat CORROSION regardless of Wall Thickness

Type Corrosion More Wall?

Contamination No advantage
Discoloration No advantage
Intergranular No advantage
Galvanic No advantage

Atmospheric May be advantage
Pitting Little advantage
Inches Penetration

Year May be advantage

CHANGED ANALYSIS and LESS WALL can be GREATER COST ADVANTAGE than CHANGED ANALYSIS and SAME WALL.

Speedline FITTINGS DESIGNED FOR SCHEDULES 5 AND 10 GIVE YOU:

lower installation costs

for labor



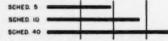
SPEEDLINE ALIGNING CONNECTORS

Speed Installation

*Can be Welded, Fused, Soldered or Brazed

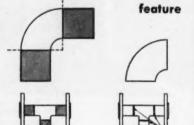
Provide Easy Change-over from Schedule 40 to 5 or 10

for materials



You pay much less for light wall pipe. Here's a cost comparison of the three schedules in 1" size.

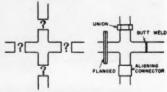
exclusive tangential



Provides Easier Aligning (with or without aligning connectors), more clearance for Welding or Flanging on ALL Speedline Formed Fittings. See gray panel below.

greater flexibility

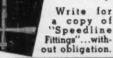
Type of Joint can be selected "on the job."

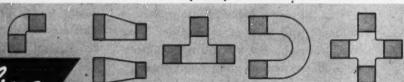


FEWER DESIGN HOURS FEWER INVENTORY ITEMS

SPEEDLINE "Multiple Choice" Fittings eliminate conventional flanged fittings, provide time and cost advantages of simple layouts versus elaborate and costly designs.

Speedline distributors are located in principal cities from coast to coast





Speedline

Corrosion-Resistant FITTINGS—the newest thing in pipeline economy

Manufactured by HORACE T. POTTS CO. - 500 E. Erie Avenue - Philadelphia 34, Penna.

PRESSUR COOKER for GAS

AN ACME-FABRICATED WELDMENT

This odd-appearing structure, made of type 310 stainless steel, is now hard at work in a catalytic cracking plant for one of the nation's largest utility companies. It's one more example of the many unusual pressure vessels being fabricated by Acme for chemical processing installations every-

where. Whether the vessel or component you need is large or small, irregular in shape or unusual in design, Acme's complete facilities - including the latest mobile X-Ray equipment - guarantee you exact adherence to your specifications as well as to your delivery schedules. Find out now why so many important companies specify Acme weldments . . . call us today.

STEEL . STAINLESS STEEL . EVERDUR . ALLOYS

A.S.M.E. U68-U69 Qualified Welders . A.F.

Underwriters Label and Inspection Service

National Board Approved • Hartford Steam Boiler Inspection Service

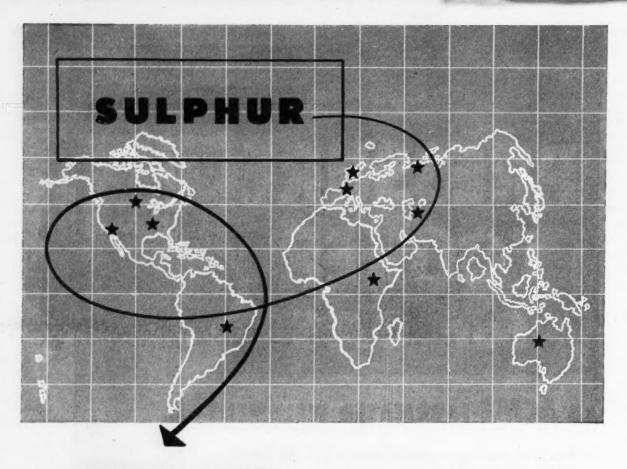


Send us your blueprints for a prompt quotation and ask for our informative folder, ACME PLANNED WELDMEN? FABRICATION.

UNITED TOOL

1054 New Britain Ave. . West Hartford 10, Conn.

National Representative TRANSMISSION EQUIPMENT CO., Inc. 441 LEXINGTON AVE., NEW YORK 17, N. Y.



the UNITED STATES is only one producing country!

Although the United States is the largest producer of elemental sulphur, its production is only about one-half of sulphur in all forms produced in the free world.*

Sulphides of iron, copper, zinc and hydrogen and calcium sulphate are all sources of sulphur dioxide, the starting point of the manufacture of that universal and all important chemical tool, sulphuric acid.

Elemental sulphur, per se, is essential for such compounds as carbon bisulphide, rubber vulcanizing and certain fungicides, insecticides and black powder. Economics dictate the use of the element or the sulphides or sulphate for other products and processes.

*International Minerals Conference, 1952-53

Texas Gulf Sulphur Co.

75 East 45th Street, New York 17, N. Y.



Sulphur Producing Units

- · NEWGULF, TEXAS
- . MOSS BLUFF, TEXAS
- . SPINDLETOP, TEXAS
- . WORLAND, WYOMING

Gyratory Screen

anoney in the manufacture of soda ash, according to Mathieson Chemical Corp.

Using this machine, Mathieson is producing a new coarse light soda ash product suitable for glass making. The new product, Mathieson believes, could eventually supersede "dense" soda ash heretofore generally used by glass plants.

To produce coarse light soda ash, Mathieson is completing a plant at its Saltville, Va., location that will produce 50,000 tons per year. It starts operating this fall. The new soda ash from this plant will be offered in bull carload lots at \$28 per ton f.o.b. saltville.

To further the development and make the product available to all glass makers, Mathieson has revealed that the new ash is made with a machine that has been used by the milling industry for years to sift flour. The device is a dynamically balanced gyratory sifter, and Allis-Chalmers furnished the sifters for the new soda ash plant at Saltville.

he coarse light ash has been used in the co-mercial production of glass, and large-scale coarsing glass plants show it to have all of the necessary physical properties to make good glass.

After gaining operating experience in the new Saltville plant, Mathieson expects to install additional facilities for producing the new coarse ash.

Reproduction of article in Chemical Engineering

You can use an all-metal gyratory Circle sifter to separate dry granular products into two, three or four predetermined sizes. Silk or metal cloth screens of 2 to 350 mesh may be used.

FOR MORE INFORMATION about Circle sifters or other Allis-Chalmers equipment for your industry, call your nearest A-C representative or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4329

Circle is an Allis-Chalmers trademark,

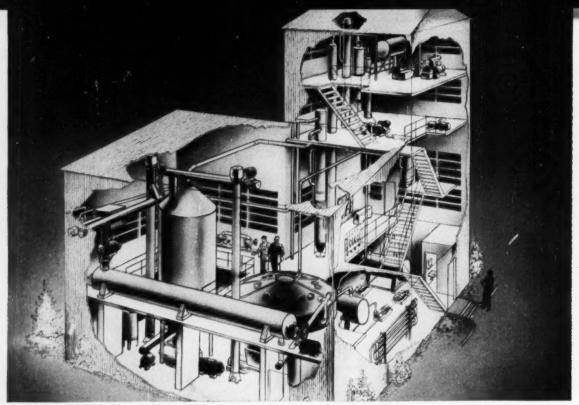
Produces Soda Ash for Glass Making

- Eliminates need for soda ash densifying plant
- End product has all the physical properties needed to produce quality glass
- Enables manufacturer to offer finished product at lower cost

This is just another example of how Allis - Chalmers equipment is helping solve today's chemical process-



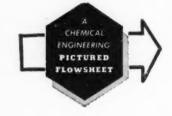
ALLIS-CHALMERS



EXTRACTION, THEN FILTRATION. A basic operation in this new, compact plant. The novel process . . .

Boosts Yield of Cottonseed Oil

- Unit Operations: extraction, filtration, distillation.
- Process feature: continuous, horizontal rotary filter.



Two unit operations—solvent extraction and then filtration on a horizontal filter—are the key steps in a new process for making cottonseed oil.

Why a horizontal filter? Because it allows for efficient, countercurrent washing of the extracted cottonseed cake. This is one reason why the process gets such a high oil recovery. And why conventional, but cumbersome, prepressing of the seed is not required.

- Proven Process—For cottonseed oil, the process has already proven itself. The first commercial plant—designed by Lukens Steel, for Mississippi Cottonseed Products Co.—is now in full scale operation down at Greenwood, Miss. But the principle of extraction, then countercurrent washing on a filter, should apply nicely to many situations where a soluble component has to be extracted from a solid.
- ► Filtration-Extraction Process—Here is how the process works at Greenwood (see flowsheet):

Cottonseed (which has been delinted and dehulled), is first cooked with steam. This prepares it for extraction and also agglomerates fines for better filtration.

Cooked cottonseed-in the form of flakes-mix with hexane in an agitated extractor. The hexane comes from the filter, and contains dissolved cottonseed oil.

Horizontal Filter—Flowing into a conveyor, the extract slurry goes to the horizontal filter.

Strong miscella passes through the filter. The solids build up as a cake on the filter pan.

The cake is subjected to three countercurrent washes—two with weak miscella and one with fresh hexane.

The wash richest in oil recycles back to the extractor.

Washed cake or "meal" is removed by a scroll. It's sent to a desolventizer and then to storage.

► Evaporation—Miscella (from the filter) is pumped through a preheater, into an evaporator.

Here hexane flashes off. The hexane vapors go to a condenser—then to a water separation tank.

▶ Oil Stripping—Oil, from the evaporator, flows to a packed oil stripper column. Here, under vacuum, it is stripped of solvent with live steam.

The hexane-steam is condensed and collected in the water separator tank. From this tank, hexane flows back as wash to the horizontal filter.

Cottonseed oil, commercially free of solvent, comes out the bottom of the oil stripper. It's pumped to an oil cooler. And then to an oil storage tank.

Valve with a long bright future

...in oil and fats handling

The Installation

At Swift & Co. technical products plant in Hammond, Indiana, where hundreds of Crane valves are handling vegetable and animal fats, various fatty acids, acid foots, etc., in storage and preparation sections.

Valve Service Ratings

SUITABILITY:

Stopped former trouble

FEATURES:

Stainless Steel trim

MAINTENANCE COST:

Zero

SERVICE LIFE:

No sign of wear after 3 years

OPERATING RESULTS:

Accurate control—clean plant

AVAILABILITY:

Crane Branches Everywhere

The Valve

It's the familiar, universallyused Crane 125-Pound OS&Y Iron Body Wedge Gate, but equipped with special Crane 18-8 SMo stainless steel trim to resist the mildly corrosive effects of fatty acids and acid foots. If you have a similar problem, this may be your solution. Ask your Crane Representative to help you.



The plant had been operating about two years when the Crane valves were installed. They were selected to replace the plant's original valves which were not maintaining the required absolute tightness when process pipe lines were shut off.

The Crane valves, now in service for more than three years, are iron body gates with stainless steel trim. Recently the plant reported: no leakage... no maintenance... no replacements. Also credited to the Crane valves: more accurate control of processes... and a much cleaner plant.

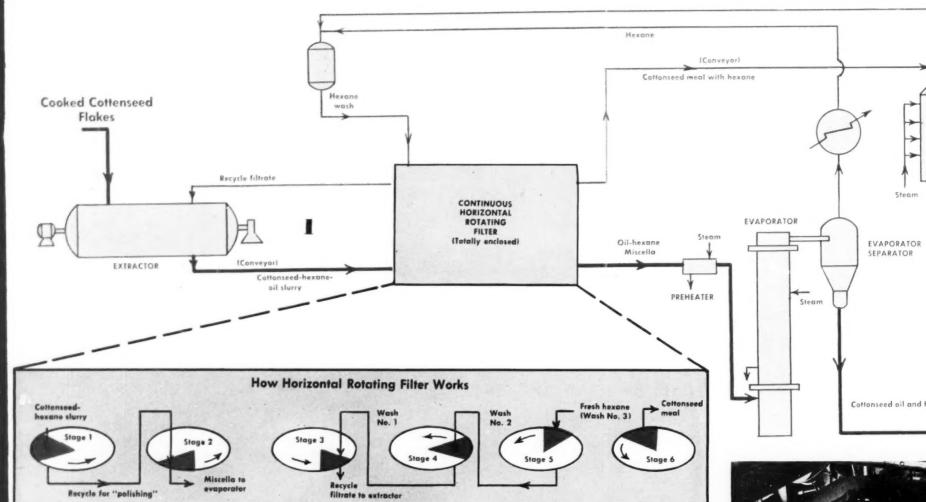
THE BETTER QUALITY... BIGGER VALUE LINE... IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., General Offices: 836 S. Michigan Ave., Chicago 5, Illinois Branches and Wholesalers Serving All Industrial Areas



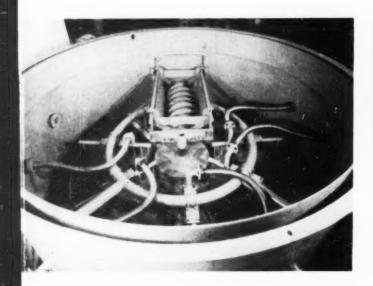
VALVES . FITTINGS . PIPE . PLUMBING . HEATING



SIX OPERATIONS go on at once in this filter. But to understand what's happening, first visualize a revolving pan, set on a ball race; with wedge-

shaped filter sections—each with a drainage port. In operation, slurry feeds to the revolving pan. Filtrate (strong miscella) passes through the pan.

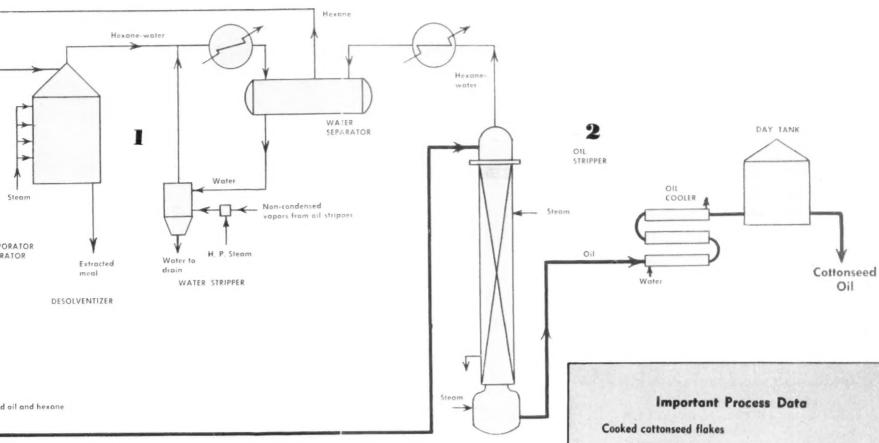
The solid cake, held on filter cloth, is washed with weak miscella and fresh hexane. Then, it's removed by a scroll.





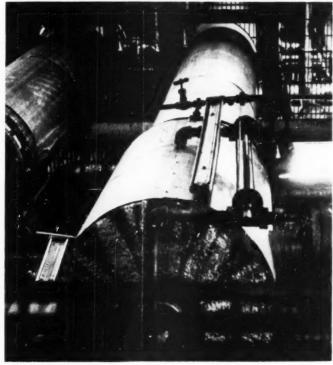


COTTONSEED EXTRACTION—wit extractor at the left. Desolventizer is at





ON-with hexane-takes place in the tizer is at the right.



DISTILLATION SYSTEM. Miscella is flash-evaporated to remove hexane; then steam stripped in a packed column.

7,100 pounds per hour fed to the extractor. Oil content is about 30 percent.

Oil

Extracted meal

4,500 pounds per hour from desolventizer. Oil content is less than 1 percent.

Cottonseed oil

2,430 pounds per hour.

Solvent loss

Less than I percent, (on weight of cottonseed).

Fresh hexane feed to horizontal filter

Flow rates of 19 to 35 gpm. Weight ratio of hexane-feed to solids-in-extractor is 0.8.

Miscella feed to evaporator

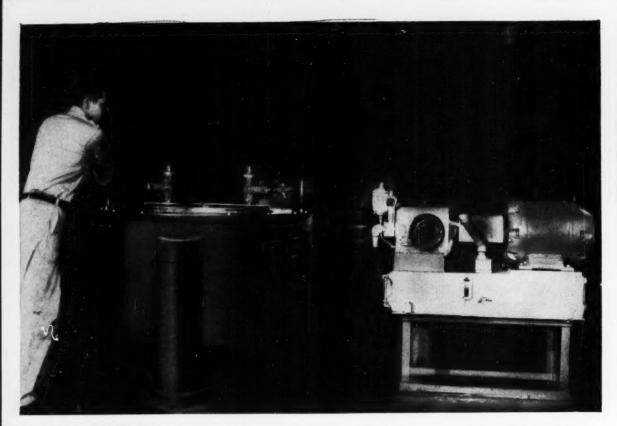
Flow rates of 19 to 35 gpm. Oil content is about 20 to 35 percent.

Horizontal filter data

10 ft. diameter. And 65 sq. ft. of filter area. Pressure drop is 3 to 18 in. Hg.

Operating personnel

One operator in the extraction plant.



CAN YOU CENTRIFUGE MORE EFFICIENTLY WITH INFINITELY VARIABLE SPEED?

Do you centrifuge any material which should be loaded, extracted, washed and unloaded, at a different speed for each step?

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East Moline, Illinois

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FEATURES:

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SERVICE LIFE:

No sign of wear after 3 years

OPERATING RESULTS:

Accurate control—clean plant

AVAILABILITY:

Crane Branches Everywhere

The Valve

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The plant had been operating about two years when the Crane valves were installed. They were selected to replace the plant's original valves which were not maintaining the required absolute tightness when process pipe lines were shut off.

The Crane valves, now in service for more than three years, are iron body gates with stainless steel trim. Recently the plant reported: no leakage...no maintenance...no replacements. Also credited to the Crane valves: more accurate control of processes...and a much cleaner plant.

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Write for Bulletin No. 73 for further details of the RAY-DUCER.

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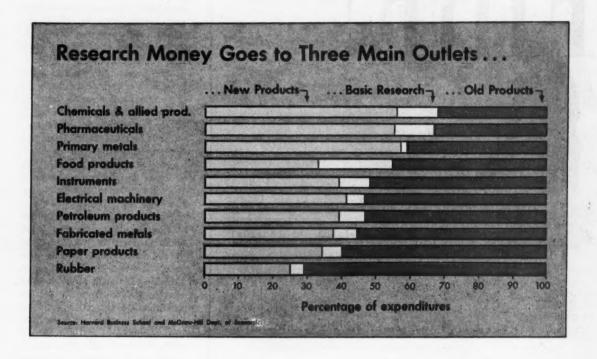


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Chemicals Lead in Private Research

Although some industries, through government financial aid, have bigger research budgets, chemical companies spend the most out of their own pockets.

William Chartener, McGraw-Hill Dept. of Economics

How much should a company spend on research? It depends on the company's basic aims and policies and on what the company expects to gain from its research expenditures.

That's the conclusion reached by Howard S. Turner of the Pittsburgh Consolidation Coal Co. in the May-June issue of the Harvard Business Review. Mr. Turner's article is based largely on surveys recently completed by the Harvard Business School which, along with a Defense Department study and the Bureau of Labor Statistics, provide a wealth of new information on industrial research.

U. S. research expenditures now

total about \$4 billion annually, nearly four times the figure for 1940. The government contributed 60 percent of the funds devoted to research in 1952, compared with 38 percent from industry and 2 percent from nonprofit institutions. But more than two-thirds of the actual work was done by private industry and another 11 percent by non-profit institutions.

Spending for the Future—The chemical industry leads all others in privately financed research—over 18 percent of the total in 1951—although government funds put the electrical machinery and aircraft industries ahead in total expenditures. More than half of the funds going

to nonprofit institutions for outside research in 1951 came from the chemicals and allied products industries.

Chemicals rate among the top industries also in research spending as a percentage of sales and as a percentage of post-tax profits—3.1 and 34.4 percent, respectively. Again the only industries exceeding chemicals—aircraft, electrical machinery and professional and scientific instruments—receive more than half their research funds from the government.

▶ Off With the Old—The dynamic character of the chemical industry is explained by the purpose of its research activities, as well as by the volume of funds spent on research. The Harvard Business School survey shows the chemicals and allied products and pharmaceutical industries devoting over 55 percent of their research money to the development of new products and more



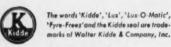
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ECONOMICS . . .

than 12 percent to uncommitted programs, or "basic" research. In most other industries—food and primary metals being the only exception—the bulk of research goes into the improvement of present products and processes.

The purpose of an individual company's research determines the size and type of program it should budget. And this purpose depends largely on the industry you're in.

If the object is merely to protect the company's position from advances in existing products and processes by competitors, then a modest program is enough. If, on the other hand, your aim is to get the jump on competitors through pioneering in new products and methods, then the purse must be opened wider. In an industry with such a fast rate of obsolescence as chemicals, the company that is not alert to the development of new processes and the manufacture of new and improved products may take a sound beating.

▶ Three Routes—There is also a choice in the matter of who does the research. A company can maintain its own research organization, it can contract its research with outside organizations, or it can try to keep up with the innovations developed by others. This last course can involve the payment of licensing fees or the buying of new processes as an alternative to research.

It might be supposed that heaviest use of outside research would be made by smaller companies that can't maintain their own research organizations. But the Harvard study indicates that most of the money going to nonprofit institutions for research comes from firms of medium and large size. Mr. Turner suggests that larger companies gain an advantage from supplementing their own laboratory work with that of outside specialists.

How much does a research organization cost? One of the interesting results of all three surveys mentioned previously is that the cost per research worker varies very little from industry to industry. The cost per research engineer or scientist, however, varies a great deal. Average cost varies also with the

size of companies, large companies spending more per worker than smaller companies.

Scientists or Technicians?—The chemical industry ranks relatively low in research costs per worker. In 1951 the average cost per research worker in the chemical industry was \$7,900, compared with \$8,800 for all industries and \$10,900 for motor vehicles.

Average cost per research engineer or scientist, however, shows a much wider disparity. This was \$16,500 for chemicals and allied products, \$21,900 for all industries and \$68,600 for motor vehicles.

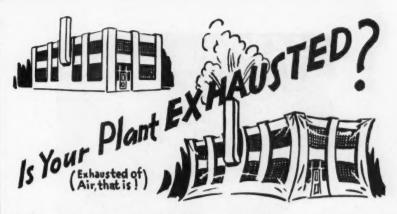
The reason for these wide cost differences between industries is the variation in "support ratios," or the number of supporting workers per engineer or scientist. Thus, the motor vehicle industry uses relatively large numbers of semi-skilled technicians, while the chemical industry relies on a high proportion of trained engineers and scientists.

▶ Facilities Cost Too—These figures on average cost of research per worker and per scientist or engineer are simply total research costs divided by the number of workers. The Harvard study also developed some separate figures on the cost of capital facilities for research.

In 1952 the median figure for annual capital expenditures for research (excluding land and buildings) per professional technical employee was \$800; half the companies reported figures between \$300 and \$1500. The estimates of replacement cost of research structures and permanent facilities per professional technical employee showed a median figure of \$21,700, with half the companies within a range of \$12,500 to \$34,100.

Mr. Turner gives as estimates for the cost of a research organization comprising 75 people, of whom 35 are professional technical employees, the following:

- Total annual expense budget -\$600,000 to \$700,000
- Addition to annual capital equipment budget—\$10,-000 to \$50,000
- Initial investment for facilities-\$400,000 to \$1,200,000



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At left is shown Fresh Air Supply Heater for mounting in roof or monitor opening.

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require no extensive duct work. They are mounted in window or wall openings or below roof or monitor openings.

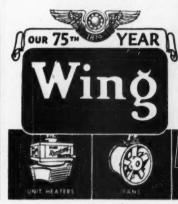
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ECONOMICS . . .

▶ Don't Go Overboard-Can you spend too much on research? Certainly! No amount of research will do a company any good unless it can be implemented, unless it leads to new or improved products that the company can make or to better processes it can adopt. An ambitious research program is wasted if the company cannot then finance the further development necessary to put a new product on the market.

What's Your Name for Our Present Economy?

No matter where you turn these days some economist is describing the state of the nation's business. But unfortunately each uses such a confusing welter of different terms that many of us end up knowing less than when we started.

At last, however, someone has come forth to deliver us. In a recent article in The New York Times, Leo Cherne* compiled a readily understandable glossary of some of the most widely used phrases. Here they are:

► Depression—An extended interval of economic difficulty lasting longer than two years. In addition, practically all branches of industry must be moving downward and the decline must be essentially continuous, except for brief fluctuations.

Mass unemployment is the symptom. Today we have 3.5 million unemployed and this will probably rise to over 4 million. But despite the fear this generates in many political, labor and business leaders, most economists insist that we will not be in a depression until business difficulty is general, business failures rise sharply and unemployment exceeds 5 million. And even then, the situation would have to continue for at least 24 months.

► Recession — Something milder than depression, although the plunge is faster and more precipitous in any few-months-period than in a depression. On the other hand, recessions do not affect all industries uniformly. Some dip, some

^{*}Executive Director of the Research Institute of America.

drop, some just level off. A few may even go up slightly.

And what's called a recession today might not even have been classified 20 years ago. The nation has been extremely sensitive to mild ups and downs, with serious psychological impact.

▶ Dip and Adjustment—These are probably far the most prevalent terms used today to describe our current economic situation. But actually they mean very little. Every period of prosperity, recession or depression, seen as a line on graph, moves either up or down and contains many minor fluctuations. These have little to do with the longer term outlook.

► Inventory Correction—This is not really a picture of general economic sickness. Rather it occurs when manufacturers and retailers have been over-optimistic in trying to guess consumer intentions.

Every depression or recession involves inventory adjustments, although this is not an overly serious factor in our present situation. The reason is that stocks of both finished and semi-finished had been reduced because last year was not expected to be as good as it actually was.

▶ Rolling Adjustment—This concept was born just before World War II. It has come to mean a period in which one or more major industries drop seriously while the rest of the economy is enjoying a boom. Then when the suffering industries start rising out of their relatively short-lived troubles, others drop down to take their place. But it's never a case of all industries being up or down at the same time.

Chemicals Lead in Consumption of Salt

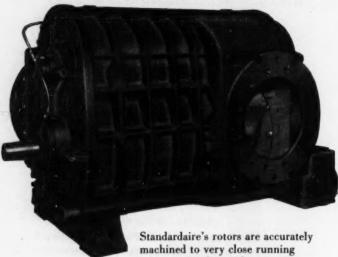
Domestic production of salt in 1953 reached an estimated 20 million tons, according to the Salt Institute, an increase of 2½ times prewar output. This is estimated to be 40 percent of total world production and approximates that of the 1951-52 period when production climbed to an all time high in this country.



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machined to very close running tolerances and provide a continuous sealing through the entire length of their engagement. Thus, the high pressure gas or air is confined at the discharge end of the Blower and leakage lines are much shorter than on other types of units.

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ECONOMICS . . .

Most of the increase can be attributed to the growth of the chemical, petrochemical and petroleum industries. Salt's use in chemical processes accounted for 68 percent of total salt production. New uses for salt in agriculture also reflected increased demand with consumption reaching nearly six percent of the total output.

Breakdown of over-all production figures shows salt brine accounting for 58 percent of the total, rock salt approximately 23 percent and evaporated, 19 percent.

New Resin Program Starting in Japan

The Japanese Ministry of International Trade and Industry has just drafted a five-year plan to triple production of synthetic resins. An investment of nearly \$42 million will be required. When the plan is completed, though, increased production is expected to save almost \$68 million of Japan's annual foreign exchange by cutting imports and promoting exports.

The following table indicates the magnitude of the proposed resin expansion:

Resin Production in Japan (Tons)

Resin	Actual 1953	Proposed 1958
Phenolic	9,650	17,000
Urea	19,400	33,000
Polyvinyl chloride	16,700	55,000
Alkyd	2,430	8,700
Polyethylene	1 2	5,000
Polystyrene		12,000
meta-Acrylic	650	3,000
Polyester	40	2,400
Silicone	25	600
Fluoric		500
Total	48,895	137,200

Use of Animal Fats In Feed Zooms Skyward

In icss than two years the use of animal fats in feeds has risen from about 10 million pounds annually to a current consumption rate in excess of 200 million pounds a year. These amazing facts are reported by the American Meat Institute in it's new Bulletin No. 9.

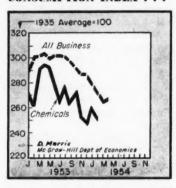
Conceivably, says the report, the feed industry could absorb the entire annual surplus of animal fats produced by meat packers and renderers, estimated at about 777 mil-

lion pounds. If only two percent of fat were added to one-half of the total commercial feed production, 780 million pounds of animal fats would be required.

In commenting on the contents of the report, Eastman Chemical Products, Inc., Kingsport, Tenn., gives substantial credit to the development of better antioxidants that give extended shelf life.

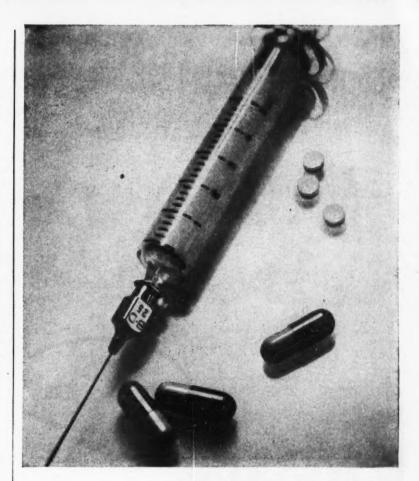
Says Eastman, "It would be an exaggeration to say (as one or two intemperate writers have said) that all this was made possible by the development of antioxidants and by their addition to the animal fat content of prepared feeds. But it would be no extranvagance to insist that without the introduction of antioxidants, and their ability to stabilize fat content, many feed manufacturers would not even have considered 'going over' to animal fats in their feed products. Many of them have said as much."

CONSUMPTION INDEX . . .



Business Activity (April)...268.3 Chemical Consumption

	March. (Prelim.)	Feb. (Rev.)
Index	286.4	252.8
Fertilizer	75.87	62.55
Pulp & paper	32.25	28.28
Petroleum ref	27.91	25.74
Iron & steel	13.37	12.99
Rayon	25.32	21.86
Glass	25.21	22.31
Paint & varnish	28.32	24.05
Textiles	10.26	9.12
Coal products	10.66	9.98
Leather	3.86	3.90
Explosives	7.94	8.03
Rubber	6.20	5.41
Plastics	19.20	18.53



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THIS MONTH'S

Names in



Wm. M. Creasy

The new chief of the U.S. Army Chemical Corps comes to his post after a 25 year association with the Corps. Most recently, he had held the post of chief of the Research and Engineering Command. Late in 1950, he took on additional responsibilities as commanding general of the Army Chemical Center.

At the age of 49, General Creasy can boast of an already lengthy career in the field of chemical warfare. In his various commands, he has emphasized research on toxic agents. He has also specialized in distillation, absorption and chlorination.

Gen. Creasy is a graduate of West Point and holds a degree in chemical engineering from MIT.

Christian de Guigne—Chairman of the board of Stauffer Chemical Co. He had been president for 8 years.

Hans Stauffer—President of Stauffer Chemical Co. Formerly, he had been executive vice president and general manager.

E. W. Weith—Technical service director for Glidden Co.'s central industrial region, Cleveland.

Richard Brief—Now associated with AEC's \$78 million feed materials plant near Fernald, Ohio, with the Nat'l Lead Co. (contractor).

M. A. Gibbons

- W. W. Frymoyer-Vice president of The Foxboro Co. In 1939, he became gen'l supt. and since 1951 he has been factory manager.
- Selden E. Doughty-Production manager of Carpenter Steel Co.'s Alloy Tube Div., Union, N. J.
- Woodman Perine—Assistant general manager of Vitro Laboratories and director of its laboratory at Silver Spring, Md.
- Joseph E. Atchison-Vice president of Parsons & Whittemore, Inc. He is the former chief of the Pulp & Paper Branch, Economic Cooperative Administration.
- Eric J. Fanton and Harry N. Patronik—New members of the engineering staff of the Dust Control Dept., Pangborn Corp., Hagerstown, Md.
- L. B. Arnold, Jr.—Technical textile consultant for American Alcolac Corp. He will specialize in sales of detergents and chemicals.
- Thomas J. Eaton—Assistant vice president of The Norwich Pharmacal Co. Since 1952, he has been assistant production manager.
- Charles C. Hornbostel-Administrative assistant to the president of Foster Wheeler Corp. He had been president of National Co., Inc.
- Richard Gruver-Research staff member with General Electric's Technical Section at Hanford, working on pile coolant effects.
- John R. Curran—Director of Engineering, The Hammel-Dahl Co. For the past 4 years, he has been the firm's chief design engineer.
- Bernard Rudner-Staff member of Davison Chemical Corp.'s re-

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NAMES . . .

search and development dept. Dr. Rudner had specialized in organic chem.

- J. Donald LaZerte—Group superviser, process development, fluorochemicals dept., Minnesota Mining & Mfg. Co., St. Paul, Minn.
- Henry T. Clark—Manager of explosives production, Atlas Powder Co. Until now, he had been manager of the firm's Richmond, Calif., works.
- P. R. Grossman—Chief research engineer at the Rsch. & Dev. Center, The Babcock & Wilcox Co., Alliance, Ohio.
- Gordon Dean—New member of the Board of Directors of the Atomic Industrial Forum, Inc. Mr. Dean, the former Chairman of the AEC, is associated with Lehman Bros.
- Eugene B. Hotchkiss—Vice president of Vitro Corp. of America, in charge of new products. For the past 8 years, he has been vice president of New Enterprises, Inc.
- Donald C. Burnham-Vice president in charge of manufacturing for Westinghouse Electric Corp. Mr. Burnham had been associated with General Motors Corp.
- Charles Thompson—Group leading in dyeing application for The Chemstrand Corp. He had been a color chemist for Burlington Mills Corp.
- John H. Hinman—Chairman of the Board of the International Paper Co. In 1943, Mr. Hinman became president after 30 years with the firm.
- Ernest Nathan—Executive vice president of the Palestine Economic Corp. This chemical engineer had been president of Sun Chemical Corp. and vice president of the Warwick Chemical Co.



Howard G. Vesper

President of the Industrial Rescarch Institute, Inc., and of its subsidiary, the California Rsch. Corp.

The new president, a graduate of California Institute of Technology, has been with Standard Oil Co. of California since 1922. At present, he is a vice president of the firm. Since the commencement of his career, he has been widely known in the petroleum industry and in research circles.

Alvin Grant-Vice president in charge of sales for Eilenberger & Assoc. Inc. Formerly, he had been export mgr. for J. Jyman & Co., Denver.

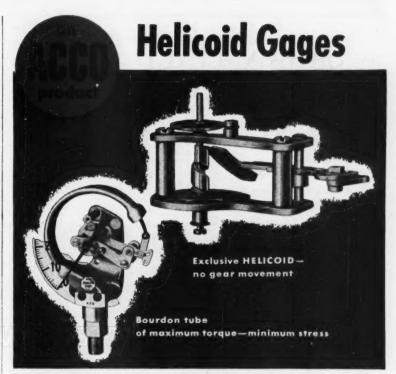
Nicholas Carr—Technical ass't to the plant manager, in Fredericksburg, Va., for American Viscose Corp.

Gwilym Price—Director of the Board of Eastman Kodak Co. Currently, Mr. Price is also president of the Westinghouse Electric Corp.

Henry Avery—Manager of the Coal Chemicals Div., Pittsburgh Coke & Chemical Co. Since 1951, he has managed the plasticizer div.

David Mayers—Foil and sheet expansion projects manager for Kaiser Aluminum & Chemical Corp.

E. R. Friese—Vice president of Sun Chemical Corp. Prior to this appointment, he had been director of manufacturing.





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HELICOID Gages have many unique and exclusive features which result in enduring accuracy and savings in maintenance cost. They cost less per gage, per year.

Only HELICOID Gages, for instance, have the Helicoid Movement...a simple cam and roller design which has no gear teeth to wear out. Bourdon tubes used in HELICOID Gages are carefully designed to give maximum torque and minimum stress...promoting the greatest possible endurance life. They withstand many millions of pressure pulsations without stretching, leaking or cracking.

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AMERICAN CHAIN & CABLE

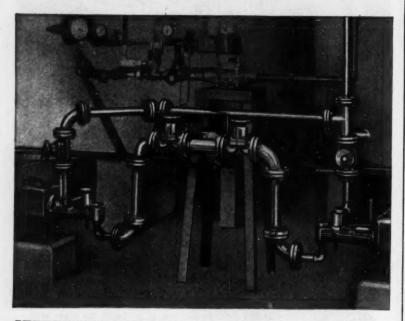
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SARAN LINED PIPE HANDLES 65% ALUM SOLUTION

Large Southeastern Paper Mill Uses Saran Lined Pipe, Fittings and Valves to Eliminate Corrosion Problems



All paper mill operators are familiar with the corrosion problems involved in handling alum solutions. Saran lined pipe, fittings and valves offer an exceptionally satisfactory answer to these difficulties by providing freedom from chemical attack plus these extra advantages:

Temperature range— -0°F. to +194°F.
Field fabrication—easily accomplished
Pressure resistance—150 psi (with cast iron fittings)
Joint tightness—unexcelled dependability
Service life—indefinitely long
Availability—immediate

We'll be glad to assist with your installation plans. Contact our nearest sales representative or write THE DOW CHEMICAL COMPANY, Midland, Mich. RELATED SARAN PRODUCTS—Saran rubber tank lining • Saran rubber molding stock • Saran tubing and fittings • Saran pipe and fittings.

you can depend on DOW PLASTICS



NAMES . . .



Gordon P. Larson

President of the national Air Pollution Control Assn. During the past year, Mr. Larson has served as the first vice-president of the association and has been one of the nine directors for the past two years. He and his technical staff have conducted a smog reduction program in Los Angeles resulting in stringent regulations for the control of dusts, fumes, vapors and gases.

Previously, Mr. Larson had been a commissioned officer in the U.S. Army Corps of Engineers (for 12 years) retiring as a Lt Colonel.

Leonard R. Constantine—Plant manager of the Catasauqua, Pa., plant of the Fuller Co. He had been a welding engineer for Elliott Co.

James Dillon-Vice president of the Nat'l Starch Products Inc. Since 1938, he has served the firm in mfg. and dev. operations.

C. A. Aloia-Recipient of the PaVac of the NY Paint & Varnish Production Club. Mr. Aloia is a senior ink chemist at Sun Chemical Co.

C. Leroy Carpenter—Vice president and technical director of Summers Fertilizer Co. and its affiliate, No. Chemical Industries, Inc.

Harry C. Webb-President of Pan American Sulphur Co., Dallas, Tex. Since 1953, he has been coordinating the construction of the firm's Frasch process production facility at Jaltipan, Veracruz, Mexico.

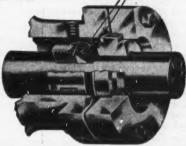
- I. V. Cavender-Group leader in the research dept. of Monsanto Chemical Co.'s Plastics Div., Texas City, Tex.
- Henry H. Storch-New staff member of American Cyanamid Co.'s Stamford Rsch. Laboratories. Presently, he is chief of the Synthetic Fuels Branch-U.S. Bureau of Mines.
- Henry S. Wingate-President of The International Nickel Co. of Canada, Ltd. Formerly, he had been vice president and a Director.
- Alexa Katona and Benjamin B. Halleck-New members of the pilot plant group and operation dept., respectively, Hooker Electrochemical Co.
- L. W. Newton-Ass't supt. of rsch. for Carbide & Carbon Chemicals Co. His work has been in the field of organic acids and plasticizers.
- William J. Haines-Technical director of The Armour Laboratories. Previously, he had been group leader for the Upjohn Co.
- Ernest F. Johnson-Associate Prof. of Chemical Engineering, Princeton University. Until 1948, he had been with Allied Chem. & Dye Corp.
- J. J. MacFarland-Assistant to the general manager of the Plastics Div. of Celanese Corp. of America. Soon after coming to Celanese-in 1947-he was made manager of the product development dept.
- Alfred G. Rossow-Staff technologist with the research and development of General Foods. Most recently, he has been associated with Monsanto Chemical Co. as eastern development representative.



Performance records plainly prove that this "John Crane" development has successfully solved the handling of the most difficult corrosive liquids and gases. Where conventional type seals had failed, the Type 9 has done the job. It continues to answer new problems, including temperature conditions from -120°F. up to 500°F.

Designed to withstand practically all chemicals, the Type 9 incorporates a flexible wedge ring and sealing ring molded from DuPont's Teflon. It is engineered for the particular application and can be furnished in the metallurgical specification best suited to the service.

Your toughest problem can be the Type 9's next success story. Use it on all rotating shaft applications, including: centrifugal, rotary pumps, mixers, agitators, autoclaves, other equipment.



Get complete information on the Type 9 Seal from Crane Packing Co., 1809 Belle Plaine Ave., Chicago 13, III. In Canada: Crane Packing Co., Ltd., 617 Parkdale Ave., N., Hamilton, Ont.



1000 sq. ft. of Filtering Surface

2000 lb. Filter Cake

The largest filter of it's type ever built



60 second opening without disconnecting piping. Available in sizes from 100 to 2000 sq. ft. of filtering area. Filter cake can be removed in a semi-dry state by hand scraping or in some cases merely tapping the plates to let the cake fall into the portable disposal receptical.

One man can handle the complete cleaning operation in ten minutes. One movement of a handle to release head bolts, a flip of a switch and the tank moves back, stopping automatically, exposing the plates in less than 60 seconds. Pipe connections are all in the stationary head, so no disconnecting of piping is required. This gives you the fastest action, time-saving, labor-saving tank opening ever engineered in a filter.

Jet pressure spray tubes can be supplied in this filter for washing off cake or in combination with backwashing when the material filtered and sewer conditions permit this type of cleaning.

Filter tanks can be supplied in mild steel, stainless steel, Hastelloy or other metals to meet requirements.

Write Mr. Eric Anderson for personal service

Ten outstanding features

- Large flow volume—large plate area up to 2000 sq. ft, and 1 ton cake.
- 2. One man fingertip operation.
- 3. No pipe lines to break in opening filter.
- Filter seal of plates not broken in cleaning.
- 5. Self sealing cover gasket.
- 6. Dry cake disposal or flush down cleaning.
- No head room required above filter.
- 8. Complete plate drainage.
- 9. Uniform precoating.
- 10. Quick opening cover.



European Plant: Sporkler International Ltd., Prinsengracht 876, Amsterdam, Holland. Canadian Plant: Sporkler International Ltd., Galt, Ontario, Canada. THIS MONTH'S

Man of



CHARLES E. BOLTE

Chemical engineer becomes second in command of the U. S. Army.

"A certain amount of fleas is good for a dog." These words from David Harum posted prominently on a desk first used by William Tecumsch Sherman help a chemical engineer keep a sense of proportion between the big and little parts of his job.

The engineer: General Charles E. Bolte. The job: vice chief of staff of the U. S. Army.

But what does a chemical engineering background have to do with being second in command of the U. S. Army? "Too little," says General Bolte.

It was simply a case of a later love—the Army—coming before his first. While studying chemical engineering at Armour—now Illinois—Institute of Technology, Bolte went to the first of the Army's summer camps for college students, set up soon after World War I began to flare in Europe. He went back again and again during his collegiate summers. And, during his third encampment decided to apply for a regular commission.

When family disapproval mounted, he fell back on his military training and beat a "strategic withdrawal"—applying instead for a reserve commission.

the Month

H. T. Sharp

After acquiring his BS in chemical engineering—and the coveted reserve commission—in the spring of 1917 he went into industry. Come fall, however, he applied for and was granted a regular commission as an infantry second lieutenant.

It wasn't too long before young Lieut. Bolte found himself with the AEF on French battlefields. He compiled an outstanding record as a regimental staff officer and a company commander in that war, and came home with several decorations—including the Purple Heart.

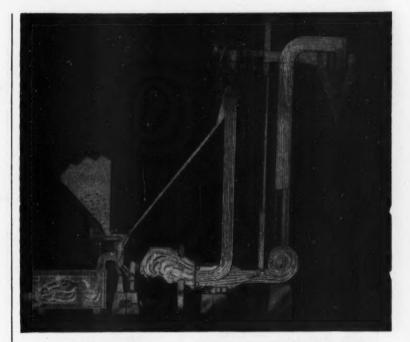
Following the armistice, Bolte decided to remain in service and thus a top-notch engineer-administrator was lost to the chemical industry.

Between wars he steadily climbed the command ladder to where, as commanding general, he led the 34th Infantry Div. in its push up through Italy during World War II. After the war Bolte served for a time as deputy chief of staff of the army.

And in 1952, he went to Germany—with the four stars of a full general—to head up all American army activities in Western Germany. In this post he administered an annual budget of between \$3 and \$4 billion, operated schools for some 23,000 children of American military and civilian personnel and supervised all army exchanges—an



For a chemical engineer: A top Army job.



It <u>DRIES</u> while it <u>GRINDS</u> while it <u>CLASSIFIES</u>

THE HARDINGE "THERMOMILL"

The Hardinge "Thermomill" is an ingenious combination of Conical Mill, air classification system and air preheater. It dries, grinds and classifies—in a single system — materials carrying an appreciable amount of surface moisture, reducing them to dry, finely-ground products. Write for Bulletin 17-B-11.

The new "GYROTOR"

is a key item in the "Thermomill"

The new Hardinge "Gyrotor" Air Classifier is a separator designed for close control of products. It has a wide range of fineness, controlled by simply changing the rotor speed. Overall classifier efficiency is higher than any attained by similar devices heretofore. Bulletin AH-449-11



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NAMES . . .

operation involving several hundred million dollars per year.

He was in this post when Gen. Matthew Ridgeway brought him back to Washington to become his vice chief of staff.

His alma mater recognized Gen. Bolte's achievements in 1944 when it bestowed upon him an honorary doctor of engineering.* The IIT citation read: "For contributions to military science in the form of tactics, operation and logistics, giving striking evidence of a logical engineering mind."

Long acquaintance with chemical engineering, Bolte feels, has aided him in his Pentagon posts by giving him a background with which to better evaluate some of the more technical parts of the army's research and development activities.

Too, it has given him a tie to such men as Dr. Karl Johann Freudenberg, dean of chemistry at the University of Heidelberg who became his close friend.

Gen. Bolte and his wife now live at Fort Myer—about 10 minutes from his Penagon desk. The Bolte's have two sons, both of whom served in Korea following graduation from West Point, and a daughter a Purdue grad.

*At the same time doctorates went to Dow's Willard Dow and Carbide's James Rafferty.

Walter A. Wachholtz—Vice president of the Arthur C. Trask Co., manufacturer of industrial chemicals. This chemical engineer has specialized in the paint and varnish field.

George Stafford Whitby-Winner of the 1954 Charles Goodyear Medal. He is credited with introducing factory techniques for handling and coagulating rubber latex in preparing a uniform product.

William J. Van Akin-Member of the board of Directors of the Ruberoid Co. Formerly, this chemical engineer had been manager of manufacturing and a vice president. Emil Hladky—Manager of American Cyanamid Co's new titanium dioxide pigment plant now under construction near Savannah, Ga. Since graduation from Columbia as a chemical engineer, he has spent 18 years in the South.

OBITUARIES

Edgar F. Schaefer—President of the Gardner-Denver Co., died in Quincy, Ill., May 2. This industrial leader joined the firm in 1919; previously held the position of ass't sales manager.

Roy A. Plumb—Founder of the Truscon Laboratories, Detroit, passed away April 28, at the age of 70. This chemical engineer was also a director of Devoe & Raynolds Co.

Otto Diels—Co-recipient of the 1950 Nobel Prize for chemistry (with Kurt Alder) died recently in Germany at the age of 78. They developed the chemical reaction involved in aldrin and dieldrin synthesis.

Joseph A. Galvin-Chairman of the Board of Rexall Drug, Inc., since 1943, died May 10. Mr. Galvin had been associated with the firm for almost 50 years.

Albert A. Hoffman—Vice president and director of Calaveras Cement Co. died May 4 in Oakland, Calif. This veteran mining engineer had also been a manager of the American Potash & Chemical Corp.

H. W. Dell-Assistant to the technical director of The Glidden Co.'s paint and varnish div., Cleveland, died on April 2, at the age of 49. This chemical engineer came to the firm in 1925.

Karl Turk, Sr.—Chairman of the Board of Pemco Corp., Baltimore, died at the age of 72. Since 1903, he has worked for the development of modern porcelain enameling.



Keep Merchandise Moving with Roller or Belt Conveyor

• With an experience record of more than 45 years—Standard is known as headquarters for any "package" conveyor need—can help you to handle packages, parts, units—faster—at lower cost with gravity or power roller, belt, slat, chain, wheel or pushbar conveyors. For complete information write Dept. CE-74.



Load-Unload • Stack • Elevate with a HANDIPILER

Handles sacks, boxes, cases, cartons, bundles—conveys up or down. Built in 14 and 24 inch widths; boom is designed to pile cartons up to 17 ft.—sacks to 12 ft.—projects into cars, trucks, trailers. Handles commodities up to 135 lbs. Write Dept. CE-74 for Bulletins 63-D.

Build Your Own System with Standard HANDIDRIVE Pro-Built Units . . .



STANDARD CONVEYOR COMPANY
General Offices: North St. Paul 9, Minnesota
Sales and Service in Principal Cities

• Handidrive belt, live roller and gravity roller conveyors consist of drive and take up units, and roller assemblies, intermediate framework, supports and hanger, to make complete conveyors—or to convert present gravity conveyors to power conveyors. Write for Bulletin 63-D, address Dept. CE-74.

Send for Bulletin 63-D, describing the above and ather Standard Conveyor equipment. Address Dept. CE-74.



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SUPERIOR SEPARATOR COMPANY HOPKINS, MINNESOTA

ENGINEER'S SERVICE REPORT

Engine G.W. Luger

Town Hopkins

State Minnesota Seriel

Clinton Stot

THIS MONTH'S

Letters:

First Report: SUPERIOR'Air Centrifuge' installation at Pillsbury Mills, Inc...

INSTALLATION [7]

SERVICE GUARANTEE

Pillsbury Sovbean Plant

SERVICE CHARGE

MATERIAL CHARGE

NATURE OF WORK First inspection of DC-38A after initial run of

78 continuous 24-hour days.

DETAILS Machine seemed in very good Condition with no defects.

They were still satisfied with performance and had no complaints.

The following conditions were observed after close inspection:

1. 18 layer of dust on top inside of machine.

2. 1/16" to 32 layer of dust on top of cone-no pattern to film of dust.

3. Bottom of machine inside rotor was clean of all dust except to within 3-4" of screen.

4. Rotor is operating satisfactorily.

5 Cleanout disc clean of material. Clean under cleanout disc.

6. Airlock is clean and free of sticky material.

7. Discharge pipe taking material from centrifuge airlock has a I to 2" coating of wet sticky material. This moisture comes

from the conveyor into which the solids discharge pipe empties.

8. Inside shell is clean of material.

9. There appears to be no wear on inside of shell after close inspection.
10. Graphite ring and bellows are fairly clean of material. Might have

to clean bellows occasionally (6 Mos)

11. There should be no trouble with bellows and ring.

12. Looking at discharge pipe on roof-no evidence of loss of material.

13. The V belts were loose and one fan bearing ran hot.



"...still satisfied with the performance, and have no complaints!"

IN YOUR PLANT, TOO, the unusual new Superior Air Centrifuge may prove to be the answer to many unsolved solids recovery and dust removal problems.

PILLSBURY MILLS, INC. has found the DC-38A Air Centrifuge very satisfactory. H. W. Eikenberry of the Feed & Soy Division writes: "We placed our DC-38A in operation on Dec. 26, 1953, and operated it continuously for 78 days. During this period we encountered no troubles. Without performing any maintenance, this machine was again placed in operation on March 19, 1954, and has given continuous, trouble-free operation to date."

THE COMPACT DC-38A is adaptable to plant air flow systems wherever machines such as grinders, pulverizers, dryers, purifiers, solvent extractors, mixers, blenders, etc., are involved. Because it separates by a patented, impelled-centrifuge principle, no filters, screens, liquids or electrostatic charges are needed.

BEFORE YOU BUY any dust removal or particle recovery equipment, get the complete story on the Superior Air Centrifuge. Call or write:

THE SUPERIOR GRAIN SEPARATOR CO.
HOPKINS, MINNESOTA



1,000 Tons Per Hour—By Air

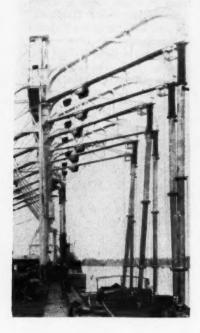
In reference to the article by Wilbur G. Hudson entitled "Why Use Pneumatic Conveyors?" in your April issue (pp. 191-194) please refer to Fig. 6 which shows pneumatic unloaders at Albany, N. Y., removing grain from barges (see cut).

You may be interested in further details on this unit—believed to be the largest pneumatic grain unloading system in this country—which was designed, manufactured and installed by Brady.

The system has eight suction pipes, each capable of handling wheat at an average rate of 3,500 bu. per hr. At the maximum, the rate of flow is more than 4,000 bu. per hr. per unit. The entire unit handles some 1,000 tons per hour.

Each of the eight units is equipped with a centrifugal exhauster. Nozzles are lowered and raised by an electrically operated hoist and a telescopic arrangement of pipes. . . .

These pneumatic conveyors, installed 22 years ago, have attracted



much attention . . . and are still the largest grain unloading system of their type.

A. E. COHEN

Vice President Brady Conveyors Corp. Chicago, Ill.

►We appreciate this additional information from Mr. Cohen on an unusual pneumatic handling installation.

Centrifugal exhausters used on the system are constant-pressure, variable-volume machines. Limit for a single unit is about 2 psi. so that two units in series gives the 4 psi. suction required. Power requirement for such a layout—with free-flowing granular materials—is about 1.7 hp. per ton per hr.—Ed.

Editor Pulls Big Boner!

Sir:

Your efforts to improve the editorial format of Chemical Engineering certainly are not going unnoticed, and I want to express my appreciation for your efforts in that behalf.

In this connection, let me point out some sort of coincidence which shows up on p. 382-383 of the April issue.

On page 383, there is described another of the very interesting

Another SSS first-0.03 Max. Carbon Stainless Castings



...to stop CORROSION even at the weld

Now, for the first time you can specify 0.03 Max. Carbon stainless castings, in many forms, for greater corrosion resistance. ESCO offers static and centrifugal castings in all 18-8 and 18-8 MO analyses, which are guaranteed to contain a maximum of only 0.03 per cent carbon.

No Carbide-Dissolving Anneal Needed After Welding

Most castings must be welded to component parts during installation. The higher the carbon content of a casting the more "carbide precipitation" during welding. Carbide precipitation often means severe corrosion adjacent to welds—unless the casting is heat-treated after welding. Heat-treating after fabrication is an always difficult, sometimes impossible job.

ESCO 0.03 max. carbon castings can be welded into working position

and be ready for action immediately—without loss of corrosion resistance. Result: Dependable, corrosion-resistant operation. A definite cut in operating costs.

Excellent Welding Characteristics

ESCO 0.03 max. carbon castings may be welded as easily as any 18-8 grade of stainless—without harmful carbide precipitation.

Available Now

ESCO welcomes your inquiries on 0.03 max. carbon castings and a wide variety of other static and centrifugally-cast stainless and high alloy products.

We are equipped to produce to your specifications on one casting or an entire installation. If you prefer, our high alloy engineers will make a complete study of your corrosion problems. Or write for booklet 175, "Esco Stainless and High Alloy Products for the Process Industries" to: Electric Steel Foundry Company, 2162 N. W. 25th Avenue, Portland 10, Oregon.

...the toughest corrosion problems wind up at...



ELECTRIC STEEL FOUNDRY CO.

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PRO & CON : . .

"Little Boner" series, and immediately preceding that is the publication of a cost index to Perry's "Chemical Engineers' Handbook" compiled and sent to you by James B. Weaver.

The "Little Boner" about this particular thing is the fact that Mr. Weaver's carefully compiled list has been published in such a way that it is impossible to cut it out and paste it inside the cover of Perry where it belongs. If you paste in part of it exposed, the rest of it is covered up.

How about it?

W. A. CUNNINGHAM

Chairman
Department of Chemical
Engineering
University of Texas
Austin, Texas

➤ Yes, we got caught in a 'little boner' of our own making, more's the shame!
Next time we publish a similar cost index—which will be soon—we'll keep our wits about us.—ED.

Your Chance to Vote

Sir

Don't get me wrong. I'm strongly with the 94 percent of your readers in favor of your new format. You've come a long way.

Re: your trouble with odd-page features, however, I have a suggestion. Like R. S. Wiener I can't clip all articles without losing parts of some. And I don't like mixed fare—advertisements and editorial, especially features.

But I'm willing to compromise. So I suggest that odd-page features be continued to a rear page where they may be backed with an ad.

I realize "continueds" are now taboo; but if a reader is interested enough to get to the last page, he will probably be interested enough to flip a few more to finish. On the other hand, the reader not interested in that article is spared the results of any of the solutions you posed in answer to Mr. Wiener in your April issue (p. 378).

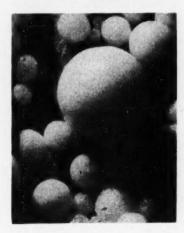
The article in question could then be clipped (with a little trouble, I'll admit) as a complete item without destroying others. Incidentally, congrats again on the Corrigan CE Refresher Series.

GEORGE M. BONNETT

N. N. S. & D. D. Co. Newport News, Va.

▶ We'd like to hear from more of our readers on this point of making more feature articles clippable as complete units without destroying parts of adjacent articles.

How many of you would vote for Mr. Bonnett's suggestion of continuing odd-page articles in the rear of the magazine among the ads?—ED.



Yes, Plastic Foam

Sir:

In the Product News section of your May issue, on p. 156, you published an interesting account of a new development in the plastics field ... moldable polystyrene beads that will balloon, upon heating, as much as 18 times by volume into a foam with interesting properties and commercial possibilities.

Would you tell me who has developed this product?

FRANK ACKERMAN

St. Louis, Mo.

► This unusual, moldable polystyrene foam (see photopraph) is a brand-new development of Koppers Co., Inc. For details on its properties and possible industrial uses, see our May issue, pp. 156-158.—ED.

We welcome short, pertinent letters from our readers giving their opinions on developments in the chemical engineering profession and in the chemical process industries. Address the Editor, Chemical Engineering, 330 West 42nd Street, New York 36, N. Y.



SET 432-HD-8

POWER FOR THE TOUGH JOBS! This is the wrench set to have at hand for the jobs that require size and power and sweeping leverage. These tools give speed as well—the big handles, adaptors and sockets are sleekly proportioned, versatile and fast working. The more powerful the wrench, the more you want safety—and Snap-on provides it—with positive button locking of units to give the security of a one-piece tool. The Loxocket release pin gives fast interchangeability of units. Available through your nearby Snap-on factory branch. For Snap-on industrial catalog, and 104-page general catalog of 4000 hand and bench tools, write

SNAP-ON TOOLS CORPORATION

8106-G 28th Avenue KENOSHA, WISCONSIN

*Snap-on is the Trademark of Snap-on Tools Corporation

HAMER

PLUG VALVES



HERE'S WHY:

HAMER Line Blind Valves

Built for strength and durability, HAMER LINE BLIND VALVES are the modern means of blinding pipe lines quickly and effectively. A oneman, one-minute operation. Cuts costs, and speeds up operations.



The plug adjusting nut, an exclusive feature on all HAMER PLUG VALVES permits the plug to be lifted slightly from its seat, making it easy to open or close the valve. A simple turn lowers the plug back into its seat and holds it there in perfect alignment. No matter what the service conditions, or lapse of time between operations, this outstanding HAMER feature assures POSITIVE E-Z turn control of the plug at all times.

Send for FREE Catalog



VALVES, INC.

2919 Gardenia Avenue Long Beach 6, California Representatives throughout to United States THIS MONTH'S

Technical

Monograph

THE BLEACHING OF PULP. Edited by R. S. Hatch. TAPPI Monograph Series—No. 10. Technical Association of the Pulp and Paper Industry, New York. 364 pages. Price \$10.

Reviewed by John L. Parsons

The preparation of this monograph was promoted soon after the war by W. F. Gillespie, then president of TAPPI, who directed Ward D. Harrison, chairman of the Pulp Purification Committee, to proceed with the project. Fourteen authors, prominent in the pulp and paper industry, were brought together to prepare this comprehensive monograph, under the able editorship of R. S. Hatch, who has had a wealth of experience in this field. Four of the fifteen chapters were written by Mr. Hatch. Contained in this volume of 364 pages are details of the bleaching techniques currently employed by the pulp industry on the North American continent.

The chapter subjects include the chlorination of pulp (R. S. Hatch), hot and cold alkaline extraction (Alexander Meller and R. S. Hatch), hypochlorite bleaching (R. S. Hatch), special bleaching agents (R. S. Hatch), and the methods employed in the bleaching of sulfite (K. G. Booth), soda and kraft (J. N. Swartz), semi-chemical (F. A. Simmonds and R. M. Kingsbury), and groundwood pulps. Special chapters are given to the bleaching of rags and raw cotton (L. A. Moss), and flax (R. W. Phelps). The longest chapter, 68 pages and 117 literature references, is devoted to the use of peroxides in pulp bleaching processes (Lyman A. Beeman and Joseph H. Reichert). Additional chapters deal with equipment and materials of construction (T. A. Pascoe), pulp washing (R. S. Hatch), historical review (S. D. Wells), and control and testing methods (M. G. Lyon). A special

Bookshelf

L. B. Pope

chapter on chlorine dioxide bleaching (W. D. Harrison) relates to the process used at the new Riegel Carolina mill, Riegelwood, N. C.

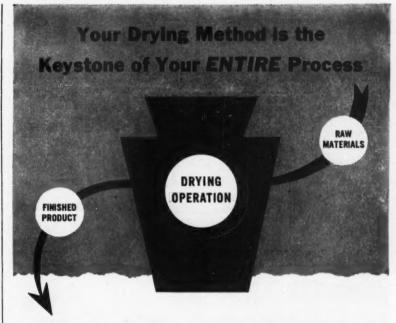
Only about 260 literature references are listed, but the editor has stated that only those references having a direct bearing on the subject matter have been included. There is no author index. The subject index is not adequate and contains errors. For instance, "reducing agents" used in the preparation of chlorine dioxide are found listed under "groundwood bleaching." A subject index with at least fifty percent more entries would be much more helpful to those who would like to use the monograph as a quick reference. The use of zinc hydrosulfite for bleaching groundwood receives scant attention in the chapter on special bleaching agents and is listed in the index only as an item in the chapter on historical review. The inclusion of a chapter on the post-treatment of bleached pulp, as related to quality and color stability, might have been worthwhile. References to this subject are scattered through several chapters but appear to be missing from the index.

This monograph is a real contribution to our knowledge of pulp bleaching and the authors are to be congratulated on their efforts to bring together in one volume the important facts on this subject. Pulp technologists and others desiring information on the bleaching of pulp fibers will find this book invaluable.

Analysis and Control

ELECTROANALYTICAL CHEMISTRY. By James J. Lingane. Interscience Publishers, Inc., New York. 448 pages. \$8.50. Reviewed by C. L. Mantell

This volume deals with the rapidly growing field of electroanalytical chemistry, and has developed into a comprehensive monograph on the entire field. After



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BOOKSHELF . . .

an introduction covering the electrogravimetric, electrographic, and electrometric methods, there follows a discussion of the e.m.f. of galvanic cells, their interpretations, the discussion of potentials, followed by pH and its measurement. The volume then devotes chapters to potentiometric titrations of the acid-base, precipitation, oxidationreduction, and automatic varieties, conductometric analysis, electrical instrumentation for controlled potential electrolysis, along with a discussion of the methodology, controlled potential electrogravimetric analysis, the procedures and prior use, internal electrolysis; controlled potential coulometric analysis with its modification of coulometric titration at constant current.

The volume is a review of technique, procedures, instrumentation, and descriptive methods covering all of the literature on the subject and coordinated in such a fashion that it becomes intensely useful and necessary to those who might want to employ the procedures of the volume. It is a "must" for the analytical and control chemist.

Spectroscopy

ELEMENTARY INTRODUC-TION TO MOLECULAR SPEC-TRA. By Borge Bak. Interscience Publishers, Inc., New York. 125 pages. \$2.90.

Reviewed by C. M. Martini

This book presents a brief survey of the field to the beginning student and to the non-spectroscopists interested in moleculor spectroscopy. After an introductory discussion of the fundamentals of the measurement and theory of spectra. the author deals more specifically with the research possibilities, the origin, and the types of information concerning molecular structure and thermodynamic properties that are obtainable, from microwave, infrared, and visible-ultraviolet spectra. For those so inclined, there is included a chapter devoted to the mathematical derivation of some of the equations important to spectroscopy. For those not so inclined, the remainder of the book, which is

written in a more qualitative manner, may be read independently of this chapter.

This contribution to the field should serve well the purpose for which it was intended.

Nobellist

THE COLLECTED PAPERS OF PETER J. W. DEBYE. Interscience Publishers, Inc., New York. 700 pages. \$9.50.

Reviewed by F. C. Nachod

On the celebration of Professor Debye's eightieth birthday a selection of his papers has been published under the editorial guidance and with short explanatory prefaces by professors Fankuchen, Fuoss, Mark, Smyth, and Sack. The publishers with the co-operation of the journals where the original papers first appeared, have produced by photo-offset an impressive monument to one of the great minds of our century.

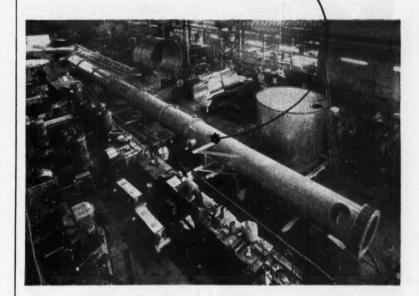
Debye is a unique personality. As a physicist he was awarded the Nobel prize in chemistry in 1936 for not one but for three distinct contributions (specific heat at low temperature, x-ray diffraction, and electrolyte theory). But his breadth of interest did not stop and his application of Lord Rayleigh's light scattering theories to high polymer chemistry became important in the rubber program during World War II.

As a theoretical physicist in his early career he became a "Zauberkünstler," a real magician, as an experimental physicist and later a physical chemist par excellence who cross-fertilized thinking in chemical and physical doctrines.

Debye has a magical gift to make clear the difficult. He always leaves his audience with the feeling: "Why didn't I think of this!" This lucidity also pervades his writings.

Those who have had the good fortune to sit in Dr. Debye's classes or heard his lectures will be delighted with this collective volume. Those who have not can perhaps experience the thrill by studying the book.

Foot Example! .. of Design and Manufacturing Skill



You're looking at an 85 foot column destined to handle a key distillation step in an important processing plant. Our engineers helped in the design and all of the fabrication was done in our own shop.

This is the kind of work we are doing for companies who need special process equipment. We are in position to help in the design as we did for this long column, bringing to the problems involved many years of experience in design and a good understanding of processing steps. Or, if only fabrication is

iAureeruna and

Process Equipment

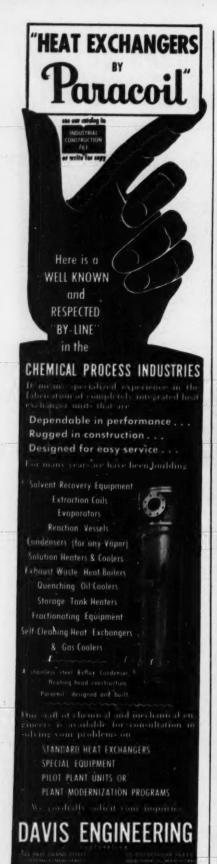
Solve Your Problem

of Our Desig

desired, we call attention to our modern, wellequipped shop and skilled workmen, long experienced in handling copper, stainless steel, aluminum, carbon, silver, nickel, inconel, brass, bronze anufacturino and all other commercially used metals.

Can we be of help in any way: design and manufacture or just manufacture to your own design?

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A new type of gloss lethe is said to handle specialized glass work in labs and some production operations. It can be used to make ring seals, flanges, closures, glass fusings. A novel sleeve grip chuck allows quick set-ups of practically all forms of glass work without elaborate accessories.

How to quench a city's thirst. Faced with the future problem of serving 100,000 people, the City of Vallejo, California, engaged Kaiser Engineers to design and direct states.

gineers to design and direct construction of a water system that would supply 21, 000,000 gallons per day to the city. This



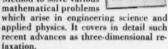
\$6,000,000 project included 36 miles of pipeline, pumping and treatment plants, reservoirs and a distribution system, Reprints of this story are available upon request.

Relaxation

Methods

D = 800 11111

Relaxation Methods by D. N. de G. Allen, recently published by Mc-Graw-Hill, explains how to use the Relaxation Method to solve various method as problems





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THIS MONTH'S

Recent Books

Chemical Productivity

A popular version of the January 1953 Report of the British Heavy Chemicals Productivity Team. This team toured through the U.S., visiting our heavy chemical industry, with the object of finding out what is behind our high output. This little booklet discusses (with illustrations) some of the highlights of the 50,000-word report that resulted from the tour. It lists the original report's 20 recommendations directed to the British heavy chemical manufactures. 8 pages.

"Good For Us. Heavy Chemicals Productivity Team Report – Popular Version." Association of British Chemical Manufactures, Cecil Chambers, 86, Strand, London, W. C. 2. 6d.

Ozone Bibliography

This useful reference book, which should be of interest to anyone dealing with ozone technology, presents 266 analytical references and 980 patent references—all on ozone. Part one covers analytical techniques (optical methods, rubber cracking methods). Part two is a complete cross-referenced index on ozone patents. 224 pages.

"Bibliography of Ozone Technology." Vol. I. Joseph Kowal, Armour Research Foundation, 10 West 35th St., Chicago 16. Ill. \$5.25.

Air Conditioning Guide

A 52 chapter volume covering almost all aspects of heating, ventilating and air conditioning. From fundamentals, to instruments and codes. It even includes a manufactures' catalog data section and a large psychrometric chart. 1,615 pages.

"Heating Ventilating Air Conditioning Guide." 32nd ed. The American Society of Heating and Ventilating Engineers, 62 Worth St., New York 13, N. Y. \$10.

& Pamphlets

Anhydrous Ammonia

An up-to-date safety data sheet on anhydrous ammonia. The pamphlet includes chemical and physical properties; notes on shipping containers, cylinders, and storage tanks; allowable concentrations, toxicity and first aid. There is also a valuable bibliography. 12 pages.

"Anhydrous Ammonia."
D-251. National Safety
Council, 425 N. Michigan Ave., Chicago 11,
Ill. 17c. for members,
34c. for non-members.

Antifreeze Tests

All ASTM methods and tests for engine antifreezes are compiled in this booklet. In addition to the usual tests, sampling methods are described. 52 pages.

"ASTM Standards on Engine Antifreezes." American Society for Testing Materials, 1916 Race St., Phil. 3, Pa.

Synthetic Detergents

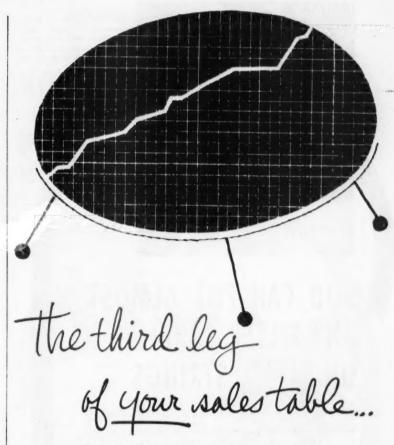
There are 96 bibliographical references in this handy little pamphlet, all on the subject—method of analysis of synthetic detergents. The years 1929 to 1951 are covered. Each reference has a short abstract. There is also a subject and author index. 20 pages.

"Bibliographical Abstracts of Methods for Analysis of Synthetic Detergents." American Society for Testing Materials, 1916 Race St., Phil. 3, Pa. \$1.25.

Soaps and Detergents

A collection of six papers dealing with the general field of detergents. Analysis of hard water soap; detergents in dry cleaning; a dynamic test for detergency; are some of the important papers included in this booklet. 28 pages.

"Papers on Soaps and Other Detergents." American Society for Testing Materials, 1916 Race St., Phil. 3, Pa.



The sales success of your product rests on a sort of three-legged table:

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- 2. Good distribution and advertising support.
- 3. A good shelf package, with BUY-APPEAL.

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General Offices — St. Louis 2, Mo. Sales Offices in Principal Cities



Pinch-Sallam San



Continuous sheet of sticky, dewatered hydrogel, neatly lifted from filter drum at top right, is carried by strings to discharge roll, falls to conveyor.

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The FEinc String Discharge Filter . . . the original rotary vacuum string filter . . . easily handles thin soupy slimes, heavy sludges, coarse granules or fibres, sticky gels . . . almost any type of cake. The strings pick the cloth clean. The cloth does not smear and plug . . . you get more filtration per foot with FEInc. Blow-back is completely unnecessary, hence there's no wire winding. There's no scraping wear, hence cloths last two to five times longer. Cloth changing takes less time, too. The strings actually help. String life is excellent.

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THIS MONTH'S

Firms in

New Facilities



Rayonier Inc.—A \$1 million addition to the woodmill at the Port Angeles Div. is being constructed to effect substantial savings in wood for chemical cellulose production.

A new two-story 5,700 sq. ft. steel building is being erected to house a new "ring" type hydraulic barker capable of handling logs up to 36 in. in diameter on a continuous basis.

The inclusion of a new whole log chipper (pictured above) will reduce a 36" diameter, 24 ft. long log into uniform chips in 14 seconds. The machine weighs over 70 tons.

W. R. Grace & Co.—The proposed merger of the Davison Chemical Corp. has been approved by the stockholders of W. R. Grace & Co., international industrial and trading concern. Headquarters of the division will be maintained in Baltimore.

International Salt Co., Inc. – A modern salt warehouse will soon be constructed to be under the supervision of the company's new midwest division. The building will contain facilities for storage as well as offices.

Goshen Rubber Co., Inc., Goshen, Ind. — Construction has been completed and pilot operations are under way in a new plant for Goshen Rubber, for the fabrication of precision-molded silicone parts.

M. A. Gibbons

Alaska Pine and Cellulose Ltd.—
Construction of a \$250,000 research laboratory in Vancouver,
B. C., will include pilot plants
for the manufacture of yarns produced from wood cellulose by
the viscose and acetate processes.

Devoe & Raynolds Co. Inc. – A \$500,000 research laboratory of Devoe & Raynolds Co., Inc., in Louisville, Ky., will concentrate on development of Devran—an cpoxy resin—as a part of a million-dollar-a-year research program.

Chicago Bridge & Iron Co. – A
Conkey Equipment Div. has
been created upon the acquisition of the Conkey Filter Co.,
New York, manufacturer of filters, evaporators and crystallizers.

Agrichem Corp.—A branch office has been opened in New York City by this dealer in bulk basic chemicals, at 99 Park Avenue. The firm's brokerage services aid both domestic and foreign consumers.

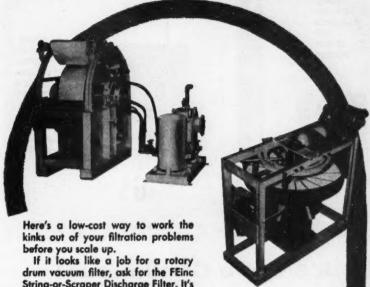
U. S.-Israel Plastics Corp. — Completion of a \$250,000 plastics factory at Holon, near Tel Aviv, for the production of plastic sheeting, film, tubing, rods and a wide variety of plastic products.

The Beech-Nut Packing Co. — A chemical department has been formed to govern the manufacture of polyvinyl acetate resins in solid and emulsion form, for the textile and adhesive fields.

Dorr Co., Stamford, Conn.—A new office has been opened in Virginia, Minn., to serve more efficiently, the iron mining industry in the region of Minnesota and Michigan.

Hooker Electrochemical Co.-Liquid caustic soda from the Tacoma, Wash., plant will be

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If it looks like a job for a rotary drum vacuum filter, ask for the FEinc String-or-Scraper Discharge Filter. It's furnished with both the FEinc String Discharge and the FEinc Scraper Discharge mechanisms. You can try first one, then the other. It also has the FEinc submergence washing and compression dewatering mechanisms. These can be operated separately or disconnected if desired. This all-purpose pilot plant filter is available to you on a unique rental-purchase plan, requires no capital investment. Ask for details.

If it's a relatively free-filtering job, such as a coarse crystalline or fibrous pulp, try the simpler FEinc Horizontal Filter first. Particularly good for counter-current or multiple-stage washing. Only 3 ft. dia., with amazingly high output.

Whatever your problem, if it's continuous filtration, talk to FEinc first. Our engineering service is backed by 35 years of experience, and by our well-known ability to deliver filters that are tailor-made to fit the job... at no more than standard cests.

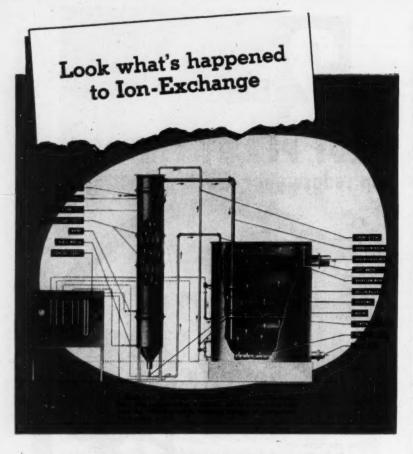


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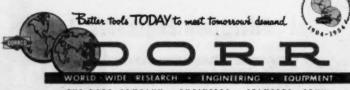


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FIRMS . . .

stored at a new bulk storage plant to be built in Vancouver, B. C.

B. K. Pancoast Co., Inc. – New grinding size separating and dry blending facilities have been installed recently in New Orleans by this New Jersey custom milling firm.



Eutectic Welding Alloys Co. of Canada, Ltd. — New premises have been acquired for the manufacture of its special purpose alloys in Canada. The firm's products include a wide range of welding and brazing alloys, solders and chemical aids.

Olin Industries, Inc. — A physical chemistry department has been established in Olin's general research organization, at New Haven, Conn.

Allied Chemical & Dye Corp. —
Completion of ammonia production facilities of the new nitrogen plant at Omaha, Neb. Urea production facilities are scheduled for completion at an early date.
Estimated total cost of plant: \$25 million.

Reilly Tar & Chemical Corp., Indianapolis, Ind.—A Detroit sales office has been opened to handle the complete line of Reilly coal tar and synthetic chemicals, pipe enamels and protective coatings.

Timken Roller Bearing Co., Canton, Ohio-A \$278,000 continuous annealing furnace will be erected at the Gambrinus plant to increase production of heavy walled seamless tubing for the oil industry.

Marblehead Lime Co., subsidiary of Material Service Corp. - A

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Key to the uniform, free-flowing chemical fertilizers produced by the Dorrco Granular Fertilizer Process

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FIRMS . . .

Thornton, Ill., plant has commenced production of clinkered dolomite. In addition, a second rotary kiln has been added.



Wagner Electric Corp., St. Louis, Mo.—A new office and warehouse building will accommodate Wagner's automotive and electrical warehouse and branch office operations.

The Continental, Shell, Superior and Union Oil Companies—Contract for the design and construction of an offshore platform capable of use for drilling operations in 250 ft. of water has been awarded by these firms to the Macco Corp. and the Stone & Webster Eng. Corp.

Enjay Co., Inc.—A building housing the newly-created Enjay Laboratories Div. will be constructed on the Standard Oil Development Co.'s Research Center grounds, to be completed by November 1954.

Witco Chemical Co.—An addition to the cooling and shipping shed at the firm's asphalt plant in Perth Amboy, N. J., has helped Witco achieve a one-third increase in output. The new fire-proofed structure represents an expenditure of \$15,000.

Dravo Corp., Pittsburgh—A southwest office in Houston, Tex., has been opened for the firm's Machinery Division. The new office will handle the sale of prefabricated steel and alloy piping for power plants and refineries.

Olsan Chemical Co., Trinity, Tex.

-Operations have commenced for this chemical firm. Several products from fullers earth are being manufactured. The plant

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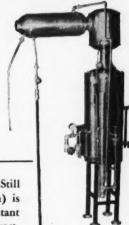
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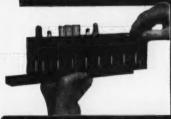
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FIRMS

is located on several acres of land east of the Trinity Clay Products.

Chicago Corp.—Agreements have been completed for the purchase of Champlin Refining Co., Enid, Okla., and its subsidiary, Peppers Refining Co., Oklahoma City, for a total of \$55 million. Capacity of the Enid plant is 22,000 b/d; the Peppers refinery is rated at 1,750 b/d.

American Ceramic Society—A \$128,000 office building for the national headquarters of the Society is planned. Ceramic materials will be used almost entirely in its construction. Contracts are now being negotiated and erection will commence shortly.

Shell Pipe Line Corp., Houston—Construction on a 65-mile products pipe line from Shell's Norco, La., refinery, just west of New Orleans, has begun. Initial capacity of the line, 50,000 b/d of kerosene, distillate fuel oil and two grades of gasoline can be increased to 80,000 in the future.

Federal Latex Corp., Brooklyn, N. Y.—An expansion program for the firm will be completed at an early date. Installation of new compounding and storage tanks will more than triple present production capacity. The firm manufactures natural and synthetic compounds for latex applications.

Reichold Chemicals, Inc.—A \$200,-000 alkyd resins-producing facilities in Azusa, Calif., have been completed. Construction of a new polyester plant on the Azusa site began early in March. Further expansion plans include a \$1 million research office building for work on chemical plasticizers.

Chemical Enterprises, Inc., New York—Has exercised an option to purchase all of the outstanding stock of nine fertilizer and equipment distributing companies.

HIGHEST QUALITY SUPERIOR CRAFTSMANSHIP

A.S.M.E. CODE

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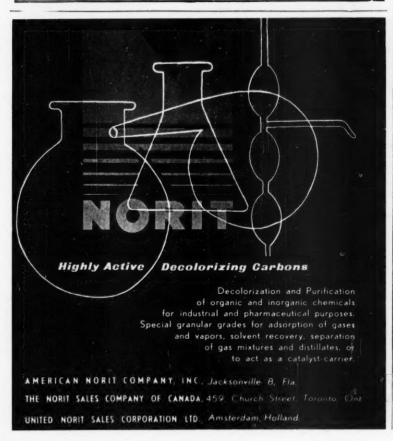
Our engineers will assist you in the selection of the most economical design for your requirements.

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NO BAFFLES NEEDED

The Cowles Dissolver mixes your batch thoroughly without using baffles—thanks to its high speed and the speed differential between the rotary motion of the batch and the impeller.

SOME VORTEX DESIRABLE

Don't be afraid of vortex! Some vortex is desirable because it provides a means for checking the impeller feed in the Cowles high speed centrifugal action.

NO PLUGGED-UP HOLES

The Cowles Dissolver has no slots or holes that can become plugged up with large chunks or balls. This makes cleaning faster, easier.

It dissolves and disperses 2 to 20 times faster in the same space ordinary mixers require. Saves time, saves labor—improves both your product and yield per batch.

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8104

FIRMS . . :

These units will continue to operate independently as affiliates of the firm. They are engaged in the production of liquid fertilizer.



W. C. Hardesty Co., Inc. – New and larger quarters will be occupied by this manufacturer of fatty acids, plasticizers and other chemical products in a move to expand the firm's over-all production program.

Universal Polychem Co., Shreveport, La.—The merger of Universal Oil Products Co. of Louisiana, Inc., into Universal Polychem Co. has been completed.

Vitro Corp. of America—Has signed a contract with the Atomic Energy Commission to continue research and development on a breeder reactor for the generation of electric power and other products. The firm is one of 26 project companies, led by Dow Chemical Co. and Detroit Edison Co., which plans to inaugurate the \$2½ million program.

Standard Oil Co. (Indiana)—Plans to build a distribution terminal near Lafayette, Ind., to serve northwest-central Indiana and part of eastern Illinois have been completed. The terminal will handle only bulk products.

Diamond Alkali Co., Chlorinated Products Div.—A new office in Atlanta, Ga., to extend territorial sales activities of the Agriculturals Chemicals Dept., has been opened.

New Representatives

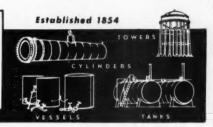
Cuno Engineering Corp., Meriden, Conn., has appointed the James

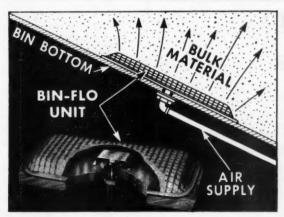


THE FIRST HUNDRED YEARS FROM a small iron-works in 1854, we have been fortunate in growing to be one of America's largest metal fabricating industries . . . For the privilege of celebrating our Centennial, we express our appreciation for the friendship of four generations of customers, and the loyalty of four generations of workers.

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USES SMALL VOLUME OF AIR AT LOW PRESSURE

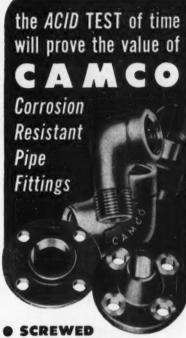
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FLANGES — (Forged to ASA and MSS standards) All flanges furnished with serrated face to insure positive gripping surface. Use of flanges to MSS standards suggested to effect substantial savings in cost.

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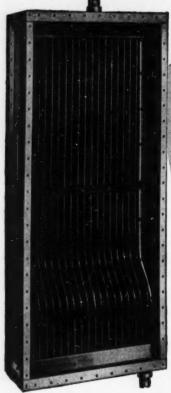
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FIRMS . . .

A. Plummer & Co. as its exclusive industrial sales representative for the Middle Atlantic States.

Cleaver-Brooks Co., Milwaukee, Wis., has selected the Lefler Wyomont Supply Co., Billings, Mont., as exclusive manufacturer's representative for the firm's self-contained boiler equipment.

Wm. Miller Instruments, Inc., Pasadena, Calif., manufacturers of instrument amplifiers and transducers, has named the Alfred Crossley & Associates as sales and service representative.

New Lines

Cameron Iron Works, Houston, Tex.—A steel fabrication service for the manufacture of high-pressure, thick-wall, forged steel pressure vessels is now being offered.

Hermas Machine Co., Inc., Hawthorne, N. J.—Exclusive manufacturing and sales rights for the "Jet" mixers (developed by David E. Gould, former vice president of Barrington Eng. Co.) have been acquired.

Knapp Mills, Inc., New York — Diversification of operations through the production of major chemical and process equipment from rigid unplasticized polyvinyl chloride.

New Companies

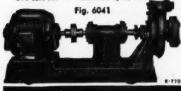
General Printing Ink Co.—The result of the consolidation of seven of the divisions of Sun Chemical Corp. into a single unit. The new company provides more complete and effective service to consumers in the East.

Shinko-Pfaudler Co., Ltd. — To manufacture glassed steel and alloy equipment in Japan. The new firm will be jointly owned by The Pfaudler Co. and the Kobe Steel Works, Ltd., Kobe, Japan. The estimated volume of business is \$3 million annually, serving the chemical industry.



WRITE on business stationery for your copy of Bulletin S-147.

TABER PUMP CO. (Est. 1859)
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Heat transfer equipment designed and built by Downingtown Iron Works will do a specific heating or cooling job in your plant —and do it efficiently.

Downingtown engineers are thoroughly experienced in designing custom-built heat exchangers for all sorts of chemical and petroleum applications... have accumulated a wealth of heat transfer data which can help solve your specific problems.

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grades of carbon steel, stainless steel, stainless and nickel alloy clad steels, nickel, nickel alloy, aluminum, copper alloy and Ampco 8 means that your quality heat transfer equipment from Dowingtown can be made of the material your job demands. Built to ASME requirements where necessary. Special welding techniques developed by Downingtown, and approved by ASME Code Inspection Agencies, assure welds that are unusually sound and neat.

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HEAT EXCHANGERS - TOWERS - PRESSURE VESSELS
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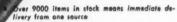
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MANUFACTURER OF HACKNEY PRODUCTS
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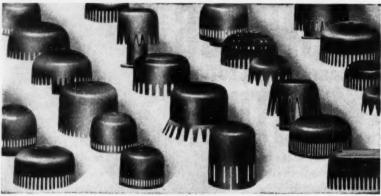
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CHEMICAL ENGINEERING—July 1954





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Clark Leasing Corp.—To finance leasing of the equipment manufactured by the parent company—Clark Equipment Co. The subsidiary was created after a successful test program in long-range, low cost leasing.

Arizona Research Laboratories – A division of Claude E. McLean & Son Laboratories, Inc., will carry on research in the various fields of chemical engineering, mining and natural resources.

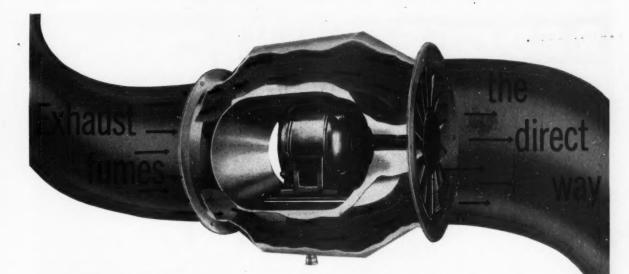
Techalloy Co., Inc.—To specialize in the cold drawing of wire in certain analyses and sizes. Production has begun with special emphasis given to wire applications requiring close material and tolerance control.

New Locations

Publicker Alcohol & Chemical Sales Corp., is moving its New York offices from 424 Madison Avenue to the Empire State Bldg., 350 Fifth Ave. The parent company, Publicker Industries, Inc., is located in Philadelphia.

Calresin Corp., has moved to 4543
Brazil St., Los Angeles 39, in order to consolidate operations with its subsidiary, Poly-Fiber, Inc. The latter company specializes in the fabrication of reinforced fiberglass.

CEC Instruments, Inc., Pasadena, Calif., electronic instrument manufacturer, has transferred its southeastern regional offices from Washington, D. C., to Atlanta, Ga., in order to provide centralized sales and service facilities for its customers in that area.



BIFURCATOR FAN EFFICIENTLY EXHAUSTS HOT, CORROSIVE, FLAMMABLE AND EXPLOSIVE FUMES

Bifurcator Fans exhaust fumes at top efficiency by avoiding a directional change in the air stream. Other fans often require a 90° change in direction of the exhaust stream with resultant loss in efficiency.

The fan motor stays clean, cool and accessible. Fumes are by-passed (bifurcated) around the motor chamber which is completely isolated from the exhaust stream.

A Bifurcator Fan is easily installed . . . just like a flanged section of ductwork. It can be mounted horizontally, vertically or at an angle. Lightweight and extremely compact, a Bifurcator requires no platform or supports. Bifurcators are available in sizes from 1140 CFM (12" diameter fan with 1/20 HP motor) up to 45,000 CFM (48" diameter fan with 20 HP motor). Housings and fan wheels can be fabricated of non-corrosive metals, or can be protected with a variety of corrosion-resistant coatings.

Be ready with the facts about Bifurcators next time you have a fume removal problem. Fill in and mail the handy coupon below . . . TODAY!



Bifurcator Fan installs just like a section of ductwork.





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Please send me "Design Data for Exhaust Systems" and Bifurcator Bulletin DB-4-52.

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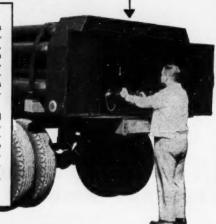
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For more efficient liquid level and flow control!

- Pilot Stem
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- . Tight Closing
- * No Internal Packing
- · Globe and Angle Patterns



- No Water Hammer
- · Non Sticking
- · Sizes 1/2" to 12"
- · Pressure to 125 lbs. Hydraulic
- Brass or Semi Steel **Bodies**

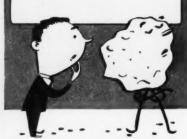
The complete line of Davis Float Valves offers a wide variety of units for almost any given service. These valves are simple in construction, rugged in service, and accurate in operation. You get efficient control with low overall expense. Davis float valves require less maintenance, preventing costly shut-downs. Let us give you complete service recom-mendation. Write today!



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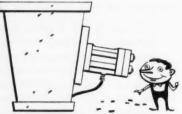
The case of the stubborn gravel...



Yes, believe it or not, chaos really reigned in this case of a Washington gravel plant . . . all because of a pile of stubborn gravel.



It bridged . . . it arched . . . it plugged . . . and generally tied up production.



After we got the facts on the case, we recommended a CLEVELAND vibrator, and in nothing flat that stubborn gravel was moving continuously and smoothly.

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AIR and ELECTRIC



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CHILLING,
DRYING COSTS

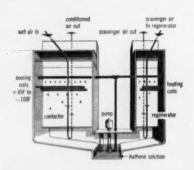
The leading manufacturers of photographic film and paper needed dry air at low temperatures for their casting, chilling, and drying processes. And they wanted it without frost, excessive reheating or aftercooling, high power requirements, carry-over, corrosion, and high maintenance and service costs.

They obtained air at the precise conditions they wanted by installing Kathabar humidity conditioning units, and avoided problems common to other dehumidification systems. For the casting process, where film dope changes from a viscous liquid to a transparent strip, Kathabar units deliver air at 104F and 47.5 grains/lb. with 53F water. For chilling the emulsion, they deliver air at 6.5F, 5 grains/lb., frost-free with OF refrigerant. For drying the emulsion, they provide 140F, 36-grain air, with 75F water.

The results have been better process control, improved product quality, and lower costs. One manufacturer, for example, saved \$40,000 annually in excess refrigeration by using Kathabar units for drying photographic paper.

Similar results have been achieved with Kathabar units in other industries: foods, pharmaceuticals, petrochemicals, brewing, glue, candy, atomic energy, lithography. For details, write for Literature Group K54-1C, including our just-published brochure, "HUMIDITY CONDITIONING."

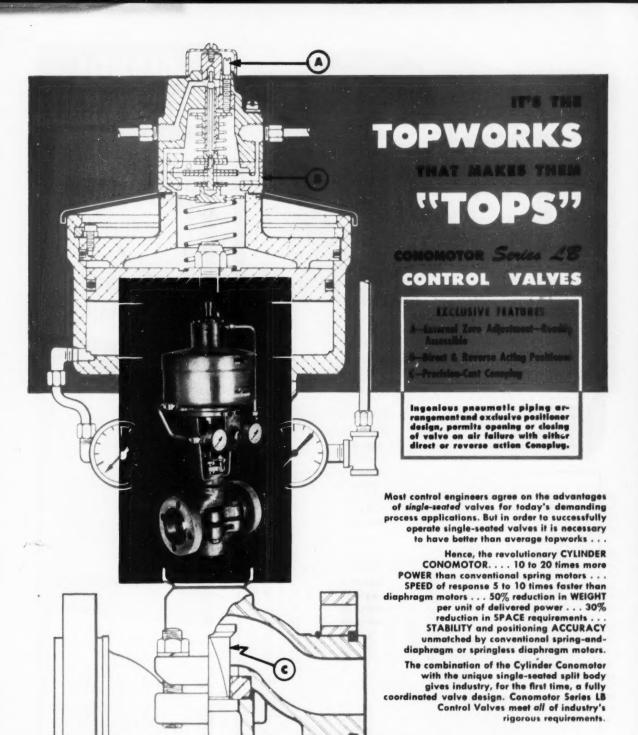
WHAT COULD BE SIMPLER?



Air to be conditioned passes through the contactor, where an absorbent solution removes moisture (the amount depends on the automatically-controlled temperature of the solution). In the automatic regeneration, about 15% of the solution is heated, and the moisture it releases is blown out the window.



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"Youth and "Beauty"

IN ENDURO EQUIPMENT



This ENDURO Stainless Steel mixing tank blends cosmetics to creamy smoothness. To sell, this product must be light, frothy, delicate. Any trace of contaminants in the creams—any foreign substance—could be sales suicide. Purity is paramount. ENDURO protects it.

ENDURO's own special beauty is more than skin deep. ENDURO equipment is solid stainless steel all the way through. There's no applied surface to chip, peel, or crack. It resists abrasion and denting. It resists rust and corrosion. It is easy to clean and to keep clean. Contaminants get no foothold.

Thus, it's easy to start each batch in shining clean

equipment. And, ENDURO never contaminates metallically. Delicate cosmetics are safe and salable.

What's more, ENDURO equipment has it own brand of built-in "youth." It stays "young," efficient, profitable to operate year after year.

Eventually, we believe, you'll want all the special advantages that only stainless steel can give your process equipment. The time to start planning is now. Republic will help. Just write:

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Match THAYER SCALES against your toughest bagging or batchweighing problems Speed up to 12 bags per minute! Accuracy to within 1/10 pound!

Whether batchweighing for formulations or bagging for shipment, you can speed filling and weighing operations — and get greater accuracy too — with a Thayer Fully-Automatic Net-Weighing Scale. Dry chemicals, plastics, etc. in powder, granulated or pellet form are readily handled by a unique feeding system that closely controls amount and rate of flow. Any free-flowing or flooding material may be handled with accuracy and speed. The entire weighing and discharging operation is completely automatic.

Thayer Net-Weighing Scales handle charges from 1 to 500 pounds. Exclusive shockproof lever-

Thayer Net-Weighing Scales handle charges from 1 to 500 pounds. Exclusive shockproof leverage system — without wear-vulnerable knife-edge pivots — guarantees continued accuracy. Hopper and feeding system are stainless steel for maximum protection against corrosion and contamination.

Thayer Gross-Weighing Scales are also available for filling directly into bags, drums and cartons.

Checkweighing Problems? ... write for information on Thayer Checkweight Scales which euromatically indicate weight of filled container and then separate off-weight units from properly filled packages! Types available for packages weighing from 1 to 200 pounds at rates up to 60 packages per minute. Latest Model 1005 automatically checkweighs bags and cartons before they are closed!



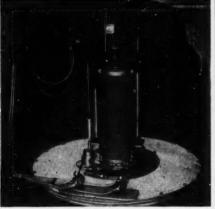
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THAYER SCALE AND ENGINEERING CORPORATION

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Fletcher PNEUMATIC UNLOADER FOR CENTRIFUGALS



The latest Fletcher development in its line of modern high-speed centrifugals is the use of pneumatic controls to greatly ease and simplify unloading operation. By this means the back-breaking and fatiguing hand cranking operation is eliminated, and the operator's efficiency is materially increased. The scraper is at all times under complete control.

The air-operated unloader also simplifies the design of a fume hood for noxious gases.

Write today for further information.

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"NO OTHER MATERIAL LASTED 3 MONTHS!"

says EASTMAN KODAK

... but bleach cells made of Boltaron 6200 remained completely unaffected by corrosion after 3 years of continuous use



Bleach cell made of Boltaron 6200 to specifications of Eastman Kodak Company, Rochester, N. Y., by Industrial Plastic Fabricators, Norwood, Mass.

"We purchased Boltaron," reports Eastman Kodak Company, "in an effort to find a superior material from which to construct bleach cells." That was in 1951. Today with 50 of these bleach cells in operation, Eastman Kodak has this to say of Boltaron 6200: "This material has solved our maintenance and replacement problem."

Boltaron 6200 is a rigid, unplasticized Polyvinyl Chloride, highly adaptable to complicated shapes and available in pipe, rod, sheet and block forms. It has outstanding resistance to both strong and weak organic and inorganic acids, alcales, alcohol, salt water and sulphite.

kalies, alcohol, salt water and sulphite.

Experienced engineering facilities are available to help you decide where and how Boltaron can be used to halt corrosion in your plant. Trained fabricators coast to coast and in Canada will work with you. Write Box 802 for further information.

H. N. HARTWELL & SON, INC.
Industrial Plastics Division
Park Square Building, Boston, Mass.



NEED EXTRA SHOCK-RESISTANCE?

Ask about high impact strength Boltaron 7200 Greenline.

July 1954—CHEMICAL ENGINEERING

Beckman Accessories for the give you a MULTI-PURPOSE ANALYTICAL TOOL

Beckman accessories to the Model DU Spectrophotometer increase the range, sensitivity, versatility and convenience of that universally accepted instrument. These accessories are built by the same people who build the basic instrument. You can employ them with every confidence, knowing that they will do the work for which they were designed.

MODEL DU PHOTOMULTIPLIER

The Photomultiplier Attachment increases the sensitivity of the DU many times, making it invaluable for measuring low-intensity radiation such as emission of weakly emitting elements in flame photometry, and low levels of fluorescence.



FLAME ATTACHMENT

Measurement of flame emissions give precise qualitative and quantitative analysis of metallic elements in a fraction of the time required by other spectrochemical methods. Modern Beckman Flame instruments detect 60 elements, 30 of them to 1 ppm or better.



Other Accessories include the following

THE ULTRAVIOLET ACCESSORY SET extends the DU's range into the very useful ultraviolet region, making its total range 220 to 1000 mµ. THE FLUORESCENCE ACCESSORY SET makes

possible extra-sensitive measurement of fluorescence, turbidity or light scattering power of a solution. THE 50-CENTIMETER CELL permits flow or static measurements on dilute solutions or weakly absorbing samples.

THE THERMOSPACER permits temperature control of samples from 0° to 100°C. THE BATTERY POWER REGULATOR provides the convenience of line operation.

Obtain more information about these and other Beckman accessories for the Model

DU Spectrophotometer by writing for Data File 40-14



REFLECTANCE ACCESSORY

The reflectance Accessory adapts the Model DU for

precision measurements of

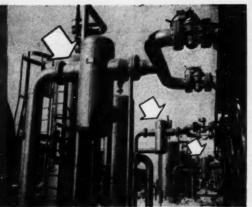
diffuse reflectance in quanti-

tative color analysis of opaque solids, powders, and

division

BECKMAN INSTRUMENTS, INC.
FULLERTON 1, CALIFORNIA

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SEE



Shown above are five Peerless line separators on outlet lines

from cooling tower efficiently extracting entrained liquid. Performance Guaranteed. Call Peerless to solve your entrainment problem.



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REPRESENTATIVES IN ALL PRINCIPAL CITIES

MULTI-WASH can clean-up your chemical contamination

Dust, fumes, vapors, soluble gases, acid gases and odors are most effectively removed.

Schneible Multi-Wash Collectors provide efficient removal of air-borne contamination and recovery of product through multiple washing action.

and recovery of product through multiple washing action.

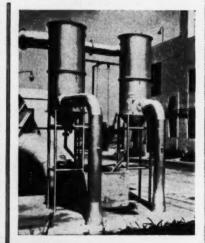
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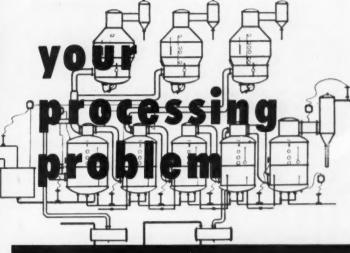


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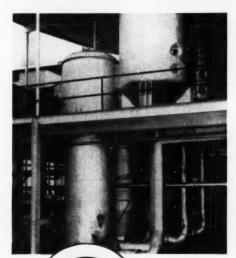
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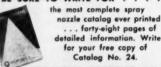




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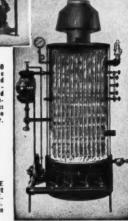
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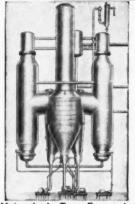
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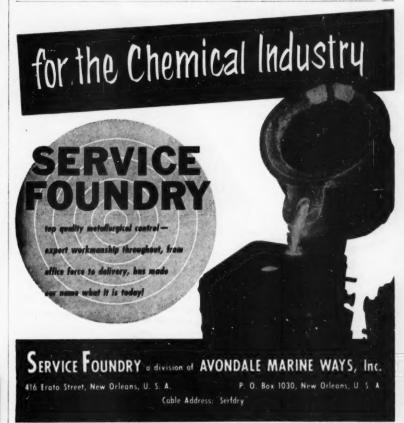
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Servo-Technology

Associate Editor Byron K. Ledgerwood, formerly an editor of Product Engineering, specialized in reporting on servomechanisms in machine and system design.

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Business Editor Lloyd E. Slater, former Industry Manager at Minneapolis-Honeywell and Associate Editor of Food Engineering, specialized in development and application of automatic controls in processing.

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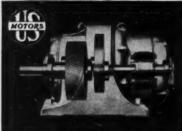
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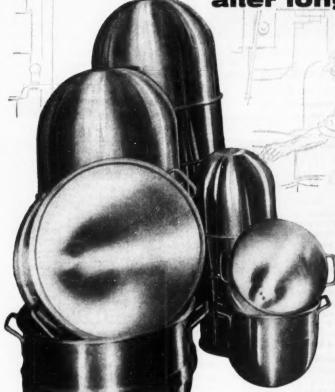
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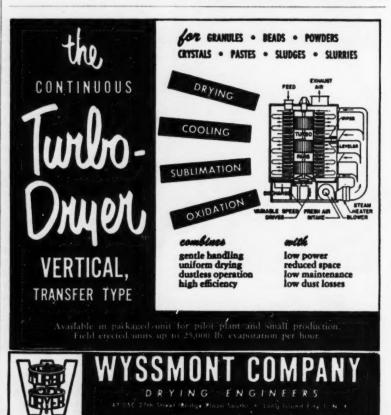


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Wanted Advertising-page 398

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KUIAK	1-10311	IAE DE	O M EK?	,
MAKE	SIZE	TYPE	Max. Press.	Max. CFM
Roots-Conn	20 x 60	8F	2	6150
Roots-Conn	22	XAS	3	19
Sutorblit	3L	Cal.	3	69
Sutorblit	4 L	Cal.	3	132
Roots-Conn	47	AF	3	124
Sutorbiit	51.	Cal.	3	249
Roots-Conn	59	AF	3	205
Roots-Conn		AP	3	360
Roots-Conn	717	AV	3	650
Sutorbilt	14 x 36	XB	3	3070
Roots-Conn	8 x 20	RCR	3.5	955
Sutorbilt	18 x 42	XB	4	5320
Roots-Conn	22 x 36	RCD	8	5500
Roots-Conn	33	AF	5	38
Roots-Conn	44	AF	- 8	. 98
Roots-Conn	97_	AF	- 5	164
Roots-Conn	710	AF	. 5	350
Roots-Conn	14 x 36	RCR		3580
Roots-Conn	16 x 24	RCD	5	2515
Roots-Conn	10 x 18	RCD	- 6	805
Butorbilt	3M	Cal.	- 6	31
Butorblit	4M	Cal.	6	76
Sutorbilt	5M	Cal.	- 6	115
Butorbilt	6M	Cal.	- 6	189
Roots-Conn	10 x 12	RC8	7	614
Roots-Conn	53	AF	7	70
Roots-Conn	76	AF	7	200
Butorbilt	4H	Cal.	10	39
Sutorbilt	SH	Cal.	10	66
Roots-Conn	65	AF	10	115
Sutorbüt	6H	Cal.	10	128
Sutorbilt	8H	Cal.	10	272
Roots-Conn	10 x 10	BCB.	10	616
Roots-Conn	10 x 736	RCD	10	440
Roots-Conn	18 x 14	RCDH	10	2100
Roots-Conn	24 x 23	RCDH	10	8610
Roots-Conn	32 x 32	RCDH	10	14950



101	KBO BLC	WEK	•	Beene
MAKE	SIZE	HP	Volume	Press.
Buffalo	ATC	12	500	46
Buffalo	410	62	500	- 62
Maxim Premix	5	57	334	1.44
Maxim Premix	7	2"	970	3.3
N. American	â.	3.6	34	314
N. American	3	3 "	34	5.12
N. American	3	14	34	9.12
N. American	3	- 12	34	212
N. American	3	- 52	34	912
N. American	3	12	34	212
N. American	3	23	84	212
General	401	1	520	4
Power Engineering	400 14	8.6	85	Ä
N. American	4	5.2	40	5
Spencer	Special	12	85	7 32
N. American	308D12	2	875	8
N. American	308A334	34	60	8
General Blower	80034	12	100	8
General Blower	80034	87	180	8
N. American	3081713	3	850	-
Robinson	30B	1 14	415	
Buffalo	610	20	3300	9
Mohr	50736	714	1650	10
Spencer	Special	1	92	10
Spencer	Special	1	92	10
Sturtevant	2	3	215	10
Fisher	F10	1	200	10
Fisher	F15	1	300	10
Eclipse	2-1	1	150	10.5
Echpse	2-1	1	150	10.5
Buffalo	SRE	736	800	12
Buffalo	580	2	300	12
Spencer	07514	34	60	12
Mohr	505	8	875	12
Mohr	505	5	875	12
Mohr	501 16	136	170	14
Eclipse	2-114	116	100	15
Spencer	1001	1	110	16
Spencer	1007	734	1000	16
Spencer	1005	5	600	16
Buffalo	4RE	10	800	24



CENTRIFUGAL FANS

MAKE	SIZE	TYPE	Wheel	Inlet
American	11	FH	6534	7374
American	9	ATTR	63.82	61
Gen. Blower	9	WC.	54	87
Buffalo	ŭ	LLD	55	56
American	7	HR	44	8016
Clarage	314	W	4214	44
Bayley New York	8	ï	40	41
New York	20	MIE	20	49
New York	36	ME	36	394
American.	500	119	30	32
Clarage	214	W	2914	3046
Bturtevant	6	Des. 3	27	2714
Buffalo	436	L.L.	2614	28
American	3.0	Eleronen	1512	12
Buffalo	- 5	LL	12	1234



STEEL PLATE EXHAUSTERS

MAKE	SIZE	TYPE	Wheel Diam.	laiet Diam
Sturtevant	100	Des 3	7214	38
Sturtevant	70	Des. 3	4914	26
American	80	ELS	4812	2034
American	70	ELS	4212	2537
American	55	ELS	3612	23
Sturtevant	50	Des. 3	36	10
New York	33	OI	33	2134
Buffalo	45	MW	32	1914
American	50	ELG.	31	1834
Gen. Blower	4.5	MX	97	1812
American	35	80	23	15
Sturtevant	30	Des. 2	18	11
American	3	VRV	13	7
American	3	V	12	-
Buffalo	416	EC.	11	ă.
Gen. Blower	20	MX	12	734
Peerless	11	PW	11	6
Peeriess.	9	PW	9	5
Alington-Curtiss .	70	- "	5614	34
Buffalo	9	WHE	6	3

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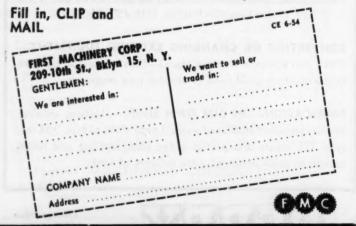
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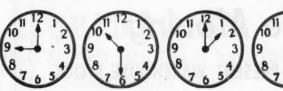
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 4-Devine Vacuum Sheli Dryers with 20, 14, 6 and 4-40''x43'' shelves.

 3-Stokes and Bullovak Rotary Vacuum Dryers 30''x8', 3'x15', 5'x30'.

 4-Buflovak double drum 60'x144'', 42''x30'', 38''x84'', 32''x32''.

 1-Devine 2'x4' Vacuum Dryen 316 S.S.

 2-Buflovak 6' dia. Crystallisers.

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 2—Oliver Monel 8'x10' Rotary-Vacs.

 2—Eimco 8'x8', 4'x5' Rotary-Vac complete
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 1—Niagara #10-20 with 12 S.S. leaves.

 1—Sparkler #33-S.17 steel filter.

 3—Vallez 500 eq. ft. Rotary Pressure.

 1—Shriver 36" P6F 42 chambers.

 4—Shriver 30" P6F 30 chambers.

 2—Sperry 24" P6F 16 chambers.

 2—Sperry Aluminum 30" and 24" P6F.

 10—Shriver, Sperry Filter Press Skeletons

 42", 36", 30", 24", 18".

Centrifugals

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 Bird 40" Suspended 347 8.S.
 Bird 40" Suspended, rubber covered.
 -A756M 36" center slung, rubber covered.
 -Tletcher 30" Suspended, steel.
 -Tolhurst 26" Suspended, steel.
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- motor. Sharples C-27, C-20 Stainless Steel Super-
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1—8° I.D. x 64° S.S. 35 trays, 55#.

1—8° O.D. x 61°6" steel, 35 trays, 55#.

1—9° I.D. x 61°6" steel, 15 trays, 83#.

1—5° O.D. x 61°6" steel, 15 trays, 83#.

1—4° O.D. x 110°6" S.S. 70 trays, 75#.

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2—1440 sq. ft. stainless steel 75# PBIG.
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3—150 sq. ft. stainless steel 850# PBIG.
1— 100 sq. ft. stainless steel 70# PBIG.
2— 33 sq. ft. stainless steel 100# PBIG.
1— 50 sq. ft. stainless steel 100# PBIG.
1— 31 sq. ft. stainless steel 100# PBIG.
12—Steel 100 to 1359 sq. ft.

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- Other Items

 Union Boiler 300 HP, 225# W.P.

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 Hardinge Mills 4½*x16", 5*x2", 5*x36",

 5*x2", 10*x68",

 Sauer 36 'Attrition Mill 2-56 HP motors.

 Patterson 6*x8', 5*x6', 4*x5', 2½*x3½*,

 brick-lined Pebble Mills.

 Abbe 3*x4', 3*x3½* Pebble Mills.

 Premier Colloid Mills 8" dia., 5.5.

 -State 30*x44 'Hammer Mill, Type A.

 -Raymond, Gayco Separators 12', 8', 5.

 -Mixor Pulverisers #2DH, #2TH, #1SH,

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 10-Hash Pumps TS12, TS8, H7, L3, MD571,
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 -Stokes Rotary Kiln, 7' x 120'.
 -Vulcan Rotary Kiln, 7' x 120'.
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- Niagara Stainless Steel Filter, Model
- -Sweetland #2 Stainless Steel Filter.
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- Swenson-Walker Type 316 Jacketed Crystallizer, 4-10' sections.

- l—Abbe #00 Rotary Cutter with 3 HP Moter. l—Mikro #2TH Stainless Steel Pulveriser. l—Mikro #3TH Mikro Pulveriser with 30 HP
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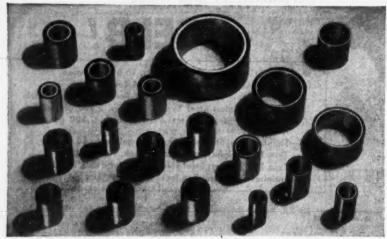
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CONDENSER AND HEAT EXCHANGER TUBE EDITION

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Bridgeport fabricates Duplex Tubes from metals selected to meet specific corrosion conditions. The number of possible combinations of such metals runs into the hundreds. On the water side, copper and its alloys offer the greatest corrosion resistance to almost every type of water composition. Typical alloys are Arsenical Admiralty (30), Arsenical Aluminum Brass (54),

Duronze IV (Arsenical Aluminum Bronze-53), Cupro Nickel (70-30, 80-20, 90-10), Copper (All Grades), Red, Yellow and Naval Brass, and 2% and 3% Silicon Bronze.

To the product side of the tube other Copper or Copper-base alloys or such metals as low carbon steel, stainless and alloy steels, aluminum, lead, Monel, nickel and tin each offer properties particularly suited to meet specific corrosive media. These and other metals and alloys can be drawn in combination either inside or outside to form Duplex Tubes.

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Bridgeport Duplex Tubes have been in actual service for over 15 years, performing successfully in oil refining, synthetic rubber production, chemical processing, by-product coking, ammonia production, refrigeration and many other applications.

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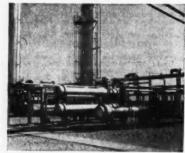
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formaldehyde, for example, use Bridgeport Duplex Tubes with Admiralty Brass outside to handle brackish water and aluminum inside to convey the product. Nitrogen compounds such as ammonia, monoethanolamine and organic cyanides are most efficiently carried by stainless or low-carbon steel tubes clad on the cooling water surface with Copper, Admiralty, Red Brass, Aluminum Brass or a Cupro Nickel alloy, depending on water composition.

Inter- and after-coolers handling various compressed gases often present a dual corrosion problem that cannot be met by single-walled tubes. Impinging gases tend to thin the tube entrance ends severely. In one instance, 0.083" wall copper tubes originally used lasted less than two years. Duplex Tube replacements—0.055" copper over 0.035" aluminum—showed scarcely any corrosion after two years exposure.

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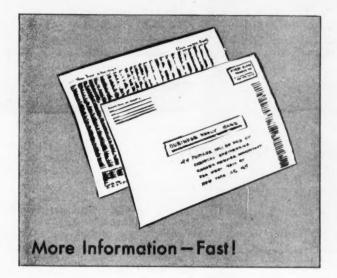
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Bridgeport Duplex Tubes bring new economy to many petroleum and chemical heat-transfer

Bulletin No. 1954. And for an invaluable reference on condenser tubes in general, ask also for the 156-page Bridgeport Condenser and Heat Exchanger Tube Handbook. For assistance in tube alloy selection, consult Bridgeport Technical Service through your local Bridgeport office. (2153)

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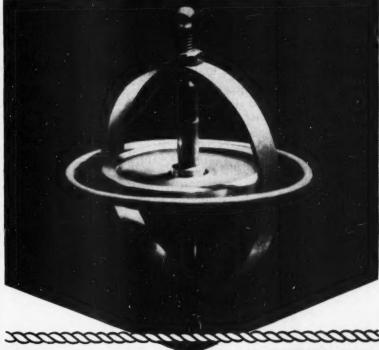
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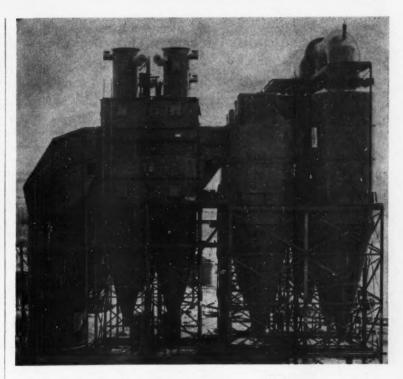
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Guide to Technical Literature

Want to build up your files and keep them up-to-date? This comprehensive guide to available literature will help you do just that. They're yours-free-for the asking.

Chemicals

- Absorbers, Ultraviolet Radiation.....Ul-traviolet radiation causes deteriora-tion of many natural and synthetic materials. Uvinuis are designed to absorb radiations and minimize such damers. damage. 412A
- Accelerators, Delayed Action.....Covers chemical & physical properties of Nobs Special accelerator & Nobs No. 1 accelerator, Graphs illustrate out-standing delayed action, 39 p. Tech-nical Bulletin 836. 412B American Cyanamid Co
- Acid, Adipic.....A versatile dibasic acid
 with many applications in plastics,
 petroleum, chemical & allied fields.
 Descriptive literature covers specifications, chemical & physical properties,
 suggested uses, etc.
 4120 E. I. du Pont de Nemours
- I, Peracetic Presents new bulle-tin describing how Becco peracetic acid 40% can be used in a very simple and satisfactory procedure for bleach-ing Nylon Type 670. Complete details in Bulletin 60.

 Buffalo Electro-Chem. Co.
- 4121
- Acid, Stearie.....Booklet describes how the outstanding stability of double pressed-type stearic acid can help keep end products fresh longer and increase sales appeal at the point-of-sale. Illustrated.
- 419E Armour Chem. Div.
- Acids, Fatty.....Produces distilled cot-tonseed fatty acids used in manufac-ture of soaps, polishes, insecticides, alkyd resins, adhesives, etc. Provides complete details in "Fatty Acids in Modern Industry."

 A. Gross & Co.
- Acids, Organic.....Offers a new, 17 p.
 Technical Bulletin on the uses of citric, gluconic, tartaric and oxalic acids and their saltz in the cleaning, polishing and plating of metals. Includes bibliography.

 Chas. Pfizer & Co.
- Aerylonitrile.....Highly stable bifunc-tional chemical finding increasing use as reactive intermediate. Literature includes abstracts which show facets of current research with this versa-tile chemical.
- American Cyanamid Co.

- Arematics, Coal Tar.....Used extensively in the paint and varnish indussively in the paint and varnish indus-try where good solvency & controlled evaporation rate are required. Com-pany furnishes complete specifications and samples. Pennsylvania Industrial Chem. controlled red. Com-
- Calicum Chloride.....Presents detailed
 40 p. manual, offered to concrete
 users so they will have ready reference to quantitative data on the
 effects of calcium chloride in concrete.
 Completely illustrated.
 4123 Calcium Cholride Institute,
- Carbon, Activated, Granular.....Avallable to help cut carbon costs and increase efficiency of your process. Initial cost is considerably lower than similar materials. Offers detailed
- literature. Pittsburgh Coke & Chem. Co.
- Catalysts, Rhodium....."Rhodium Catalysts for the Hydrogenation of Ring Compounds" covers hydrogenation of the benzene ring...the alkyl substituted ring...the hydroxyl substituted ring...etc.

 Baker & Co.
- Baker & Co. 412L
- Chemicals, Laboratory.....Offers new fully detailed Catalog listing chemi-cals for chemical, clinical, biological, bacteriological, metallurgical labora-tories and industry. Includes full
- price data. Arthur S. La Pine & Co.
- Chemicais, Melybdenum..... Molybdenum compounds widely used in production of catalysts, phosphomolybdicphosphotungstic lake colors, molybdate chrome orange pigments, etc. Technical product data.

 412N J. T. Baker Chem. Co.
- Chlorine....Offers valuable technical bulletins: #7—"Liquid Chlorine"; #8—"Alkalies & Chlorine in Treatment of Municipal & Industrial Water"; #11—"Water Analysis"; #14—"Chlorine Bleach Solvay Process Div.
- Chlorine, Liquid..... Presents new 72 p. technical and engineering service bulletin, "The Analysis of Liquid Chlorine and Bleach." Literature contains valuable data, tables, charts and indexes. No. 12. Solvay Process Div.
- Solvay Process Div.

- m-Chloroaniline Technical.....Water-white to light-amber liquid that tends to darken on storage. It can be stabilized to retard color development. Makes available fully detailed infor-
- 412P E. I. duPont de Nemours
- Copolymers, High Styrene.....Darex 43G high styrene copolymer imparts both higher hardness and unusually long fiex life to shoe soles. Abrasion and tear resistance also superior. Technical and comparative data 12Q Dewey & Almy Chem. Co.
- Defoamers.....For more efficient foam control. Versatile defoamers save space now wasted on foam, cut the processing time, eliminate waste & fire hazard of overflowing foam, etc. Offers complete details.

 L888 Dow Corning Corp.
- oamers.....For general use in the paper mill. New defoamer is highly effective as a defoaming agent in head box of paper machine & as an additive to top sizes. Details in Technical Data Sheet.

 Hart Products Corp. Defoamers.
- p-Dichlorobenzene.....Paradi offers many advantages—product-wise, prof-it-wise. Informative folder tells how to mold, compress, dissolve, perfume, color, and repackage. Complete in-formation in Bulletin 454. 4128 Hooker Electrochem. Co.
- Dicyandiamide..... Important product in synthesis of organic chemicals, is used in manufacture of resins, dyestuffs, soap stabilizers, etc. Includes data on physical & chemical properties & applications.

 412T American Cyanamid Co.
- Discoetyl Sebacate.....An outstanding vinyl plasticizer in that it combines excellent low temperature properties & low volatility. Literature includes information on usage, properties, specifications, etc.

 12U Naugatuck Chem. Div.
- Dioctyl Phthalate.....Shows marked su-periority with regard to: low color; low odor; low acidity; high heat stability; high ester content. Makes available specifications & sample
- quantities. 412V Eastman Chem. Products.
- Emulsions, Asphalt.....Replacing more expensive materials in extending certain latex, starch, resins, and plastic glues. Stable, inert, lowest cost extenders you can buy. Complete details.

 American Ritunuls & Asphalt
- American Bitumuls & Asphalt
- Ethanolamines.....40 p. Technical Bulletin includes data on shipping, sales specifications, analytical procedure, physical and chemical properties, industrial uses, handling and storage, etc.
- Jefferson Chem. Co.

Ethyl Silicate.....Releases new 20 p.
comprehensive guide to use of ethyl
silicate as refractory mold binder in
precision investment casting. Complete information along with graphs
& charts. Booklet F-8264.
Carbide & Carbon Chem. Co.

Ethylene Carbonate.....Powerful new solvent now available in commercial quantities. For use as a spinning solvent for synthetic fibers....as a solvent for resins. Complete information tion.

Carbide & Carbon Chem. Co. 413B

Ethylene Oxide..... Makes available informative literature dealing with the operating procedures for ethylene oxide..... handling, storage, & unloading. Contains charts, diagrams, etc. 16 p. Book F-7618B.

413C Carbide & Carbon Chem. Co.

2-Ethylhexanol.....Intermediate for most widely used plasticizers & sur-face-active agents...excellent solvent for many types of gums, resins, waxes. Makes available Technical Informa-tion Sheet F-7908.

Extenders.....Advantages of incorporating precipitated calcium carbonates as inert fillers, or extenders, in polyester resins used for moiding or casting products. Technical Service Bulting Witco Chem. Co.

413E Witco Chem. Co.

Flatting Agents, Alkyd-Urea Alkyd-urea flatting agents for synthetic fin-ishes. Also data on Syloid AL-1 (pre-vents pressure build-up in metallic paints). Use, chemical & physical properties, etc.

Davison Chem. Corp.

Glycerine.....Offers complete and de-tailed information on glycerine's chemical and physical properties, in available descriptive reference, "Why Glycerine for Alkyd Resins and Ester Gums?

Glycerine Producers' Assoc. 102

Hydrazine.....Now available in several forms & in a number of derivatives. Has many uses—as an exceptionally effective reducing agent, oxygen scav-enger & nitrogen "building block." enger & nitrogen "building block." Complete details, Mathleson Chem. Corp.

413F

Latex....New Technical Bulletin on use for exterior masonry paints. In-cludes information on properties results of 3 experimental exterior paint formulations based on Dow Latex 512-K.

Dow Chem. Co. 413G

Lubricants.....Company makes available a new 36 p. treatise, "Proper Lubrication.....The Life Blood of all Machinery," which deals with the important subject of modern lubrication. Data Book 54-1.

413H Fiske Bros. Refining Co.

hyl Bromide.....Offers a new infor-mational catalogue to acquaint the trade with new uses found for methyl bromide in recent years. Also includes information on the company line of M-B-C fumigants.

Eston Chem. Div. Methyl Bromide.

4131

Morpholine.....Bulletin provides data on physical & chemical properties, uses & potential applications, & presents vapor pressure, specific gravity, viscosity, surface tension, & other curves.

Jefferson Chem. Co.

ings.

4138 Pennsylvania Industrial Chem.

Naphthas, Heavy, Coal Tar.....These are semi-refined, selected coal tar fractions having excellent solvency for application ranging from wire enamels to roof coating compounds. Specifications & samples.

414A Pennsylvania Industrial Chem.



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 114B Commercial Solvents Corp.
- Oils, Heavy.....Characteristics of heavy oils make them ideal for weed killing oils, sludge solvents & tar cutbacks. Also useful in the manufacture of insecticides & disinfectants. Specifications & samples.

 414C Pennsylvania Industrial Chem.
- Oils, Solvent.....Include Shingle Stain
 Oils, neutral extenders for creosote,
 holder oils for the gas industry and
 thinners for bituminous paints. Used
 in numerous other applications. Specifications and samples
 414D Pennsylvania Industrial Chem.
- Pentaerythritol.....Offers resin-makers valuable advantages. Makes avail-able illustrated literature covering features, physical properties, indus-trial applications, alkyd resin produc-tion, etc. 12 net.
- tion, etc. 12 p. Celanese Corp. of America. 414E
- Perfumes.....An illustrated brochure,
 "How the D & O Laboratories Serve
 You," offers data on perfume, industrial odorant, aerosol, flavor & dry
 soluble seasonings product development laboratories.

 114F Dodge & Olcott.
- Phenolic Molding Compounds.....Photographs of molded parts, supported by property data tables & by case histories from industrial molders, illustrate economic advantages, "Bakelite Molding News."

 Bakelite Co.
 - Bakelite Co.
- Phosphorus Pentasulfide.....Intermediate in the manufacture of thiophosphates for oil additives, flotation agents, insecticides, & other chemicals. Makes available samples & technical information.

 Victor Chem. Wks.
- Plasticizers......63 p. detailed booklet supplies valuable information on com-pany line of plasticizers. Includes data on the uses, chemical and phy-sical properties, specifications, selec-tion, etc.

 Monsanto Chem. Co.
- 414E Monsanto Chem. Co.
- Plasticizers, Nontoxie..... Excellent non-toxic plasticizer for more important commercial resins including polyvinyl chloride and its copolymers. Offers fully-detailed information in Bulletin 0-89.
- 414J Monsanto Chem. Co.
- Polyesters.....Company makes available a 52 p. basic working text for polyes-ter formulators and users. Divided into 4 sections, the manual provides detailed data on composition and utilization of polyesters. Vational Aniline Div.
- Pelyethylene Glycols.....52 p. booklet contains pertinent information on polyethylene glycols—covers the phy-sical properties, shipping data, indus-trial applications, specifications, test methods, etc.

 Carbide & Carbon Chem. Co.
- Polymers, Propylene Oxide.....Ucon fluids & polypropylene glycols 150. 425, 1025, & 2025 are excellent lubricants & also may be used in hydraulic fluids. Offer details in Booklets F-8326, F-7220.
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- Koppers Co.
- Preservatives.....Increase manufacturing efficiency, improve product quality for cordage, paint, paper & pulp, textile, leather, petroleum, etc. industries. Literature includes complete information on uses.
- 415A Dow Chem. Co.

pylene Oxide..... Expands production of propylene oxide... to meet increasing industrial need for this excellent intermediate. Covers data on applications in Technical Information Sheet F-8485. Propylene Oxide . . .

Carbide & Carbon Chem. Co.

Resins, Fluorothene.....16 p. booklet,
"Bakelite Fluorothene Resins—Properties, Forms, Fabrication," covers valuable information on history, chemical structure, properties, fabrication, and applications.

415C Bakelite Co.

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Resins, Ion Exchange.....Nalcite cation and anion exchange resins perform with a dependability and efficiency that command confidence throughout the industry. Details in Bulletin 57, 58 and 60 58, and 60.

National Aluminate Corp.

Resins, Vinsol.....Company presents a revised & enlarged technical booklet which illustrates how low-price Vinsol resin may be used to reduce the cost of phenol-formaldehyde resins. Details in 1954 Edition.

415D Hercules Powder Co.

Protectants.....Seed decay and "damping-off" largely prevented by a very simple economical application of Spergon. Includes slurry and dry methods of seed treatment in Bulletin 4. 41510 Naugatuck Chem. Div.

Sensitizers, Gel..... Efficient and eco-nomical gel sensitizer controls the rate of gelation of latex and enables it to gel more rapidly. Technical Bulletin fully covers use in latex foam.

Armour Chem. Div.

Silicone Release Agents.....Developed for shell molders who wish to use solvent-type agents rather than water emulsions. Includes description, pro-cedure for use, typical physical prop-erties, etc.

415F

erties, etc. 4150 Dow Corning Corp.

a, Caustle......Effectively standardize processing methods. Inspections and analyses safeguard uniformity of caustic. Offers Data Sheets and Bul-letin 100 describing Hooker products and services. Hooker Electrochem. Co. Soda, Caustle . . .

Sodium Phosphates.....Offers easy-to-read data on sodium phosphates & other chemicals. Contains sections on classification, water softening, water fluoridation, plus useful tables, scales, stc.

415H Blockson Chem. Co.

8odium Trimethoxy Borohydride.....

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409 Metal Hydrides.

Solvents, Petroleum.....Feature high quality combined with uniformity & dependability...for your processing & chemical requirements. Complete information on specifications & char-ceteristics. acteristics.

Esso Standard Oil Co.

Solvents & Plasticizers.....Presents a fully detailed book, prepared to give you a practical guide to the various outstanding characteristics of com-pany line of solvents and plasticizers. Covers technical service.

Sprays, Stock.... Effective combination of lindane and toxaphene.....controls ticks, mosquitoes, flies, lice on beef cattle, sheep, hog?, etc. Furnishes a livestock pocket guide and gesetation chart.

California Spray-Chem. Corp.

Sulfonate, Alkyl Aryl.....Alkyl aryl sul-fonate in spray-dried form. Sulframin HD Bends are blended with complex phosphates and organic chemicals for high detergency value. Complete data.

416A Ultra Chem. Wks.

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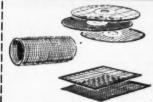
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Tackifiers.....Offers data on Koresin, a highly regarded tackifier which is a tertiary butyl phenolacetylene conden-sation product. Includes properties, solubility, compatibility, suggested uses, etc.

416B

Tetrahydro Phthalie Anhydride.....In-cludes data on the properties and dis-cusses the more important chemical reactions of the anhydride. Lists seven literature references. Technical Bulletin I-I. 4160 National Aniline Div.

Tetrapotassium Pyrophosphate.....De-tailed examination of present & poten-tial uses of TKPP in variety of industries. Data on properties, sequestration, etc., in Technical Bul-letin 505 R.

Westvaco Chem. Div.

Triethyl e-Formate.....A unique ester, closely resembling an acetal, stable in presence of aical, unstable in presence of acid, & a source for the ethoxy methylene group. Details in Technical Bulletin.

Kay-Fries Chem

Tungsten Ores.....Announces the availability of a new Brochure, which describes various methods of processing tungsten ores, particularly the froth flotation processes used on western U.S. ores.

American Cyanamid Co.

Vinyl Acetate Monomer..... Descriptive Folder includes pertinent data on the numerous industrial applications... embracing the textile, adhesives, coatings, paper and soil conditioning fields.

Celanese Corp. of America 4160

Vinyl Compounds.....Describes unique combination of physical and chemical properties offered by Plastisol com-pounds. Used for coating, casting or moiding. Offers full information in

41636 United Chromium.

Vitamin Be.....Announces a new 24 p.
Brochure containing recent nutritional and clinical information with a brief review of chronology, chemistry, pharmacy and occurrence of the vitamin in nature.

Hoffman-La Roche.

Process Equipment

Blenders, Twin Shell.....More thorough blending in fraction of the time pre-viously taken. One blender replaces methods which required a separate drum for every mix. Offers detailed Catalog 12.

Patterson-Kelley Co.

Calculators, Centrifugal Force.....Com-pany makes available upon request a handy centrifugal force calculator. This new, convenient pocket-size slide rule offers advantages of speed and accuracy.

Tolhurst Centrifugals.

Centrifugals.....Covers the advantages of infinitely variable speed hydraulic drive. Available on all center-slugge—and suspended—centrifugals. Descriptive Catalog contains complete details.

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Classifiers, Air..... Gyrotor air classifier designed for close control of products. If features a wide range of fineness, controlled by simply changing the rotor speed. Details in Buletin AH-

Hardinge Co.

Cellecters, Muiti-Wash.....For the effi-cient removal of air-borne contami-nation (dust, fumes, vapors, acid gases and odors) and recovery of product thru multiple washing action. Offers Bulletin 610.

BL356 Claude B. Schneible Co.

Discs, RuptureIllustrated booklet.

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W265

Dryers.....Work continuously, automatically, economically, extracting vaporous moistures from instrument airreducing dewpoint in air lines to as low as -100°F. Includes operation and usage.

173

Pittsburgh Lectrodryer.

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C. M. Kemp Mfg. Co.

Dryers, Vacuum..... Major improvements in dryer design and construction... provide faster, finer, cleaner opera-tion at top efficiency. Descriptive literature covers many features and

advantages.
296B Patterson Foundry & Mach. Co.

Dryers, Vacuum Chamber.....Designed to handle drying of a wide variety of materials which can be spread on trays or pans. Covers application. operation, types and sizes available, C. Illustrated.

J. P. Devine Mfg. Co.

Dust Collectors.....Reverse-jet dust col-lector provides many features: cleans as it filters—without interruption to operations; maintains filter prossit; prolongs filter life; etc. Provides com-plete information. 135 Western Precipitation Corp.

Dust Centrel.....Covers special equipment engineered to solve individual problems posed by dusts of all kinds, fly ash, chemical fumes, gases of any temperature, aerosols, etc., in Catalog A-654.

R. C. Mahon Co.

Dust Control Dust control equipment solves the problem of collecting valuable dusts—or controlling harmful dusts. Makes available Bulletin covering complete technical information. No. 800.

Dracco Corp.

Evaporators Provide evaporation as low as 45°F. and complete recovery of condensate. Operating costs 27%-55% less than steam evaporators. Stainless steel sanitary construction. Complete information. L385 Mojonnier Bros. Co.

Filters.....Describes full line of industrial Auto-Klean filters. Includes data on principles, construction, operation, advantages, specifications, capacities, applications, case studies, etc. Catalog.

Cuno Engineering Corp.

Filters, Oil. Company makes available four filter Catalogs—Industrial, Aviation, Automotive, and Fleet. Describes the many types of filters for various industries. Fully detailed and illustrated.

Purolator Products

High Vacuum Equipment.....Presents a digest of high vacuum equipment for industry, research, education. Covers data on rotary pumps, diffusion pumps, high vacuum gages, etc. Illustrated 16 p. W. Edwards & Co.

W. Edwards & Co.

Kettles, Precessing.....New double mo-tion agitator drive developed for processing kettles ... provides rapid, uniform mixing of heavy, viscous material. Covers full data on advan-tages in Catalog 356-R. 62 Buflovak Equipment Div.

Kilns, Rotary..... Every part is pre-cision designed, precision built to give you maximum protection against mechanical troubles of all kinds. Covers application data in illustrated Bulletin A-442.

Vulcan Iron Wks.

Kilns, Rotary.....Furnishes a comprehensive 40 p. illustrated bulletin which offers valuable information on the company product line of rotary kilns, coolers, dryers, and slakers. Bulletin 1115.

178a Traylor Engrg. & Mfg. Co.

Laboratory Equipment.....Assures accurate samples. Helps cut sampling costs... improve product quality... increase sales. Provides features of full-sized production machines. Data in detailed Catalog.

51 Sturtevant Mill Co.

Hardinge Co.

Mixers.....Patented design of Marion mixer guarantees precision mixing of chemicals, soaps, feeds, sweeping compounds, etc. (especially where trace materials are used). Data in illustrated Booklet.

416N Rapids Machy. Co.

Mixers.....Homo-Mixer is built & operates on an entirely new principle. Draws only from the bottom of the tank with no vortex. Contains complete information on features & operation in Catalog 402.

TL363 Admiral Tool & Die Co.

Mixers, Laboratory Laboratory mixers: electric motor driven, direct drive, variable speed and geared models. Air motor driven models also available. Offers complete details in Bulletin DH-50.

125a Mixing Equipment Co.

Mixers, Portable..... Use in industry reduces costs, saves time, labor & secures better & more refined products. Covers construction data, dimensions, specifications, etc. 28 p. Catalog B-108.

Mixing Equipment Co.

Mixers, Side Entering.....Covers de-tailed information on features, typi-cal applications, mechanical design maintenance, shaft seals, methods of installation, etc. Illustrated Catalog B-104

Mixing Equipment Co.

Mixers, Top Entering....Makes available pertinent information on top entering mixers (propeller type) ... for closed tanks, pressure and vacuum .. for open and loosed-covered tanks. Catalog B-103.

125d Mixing Equipment Co.

Porcelain Equipment.....24 p. Bulletin describes company line of chemical porcelain equipment for process ap-plications. Covers data on valves, pipe & fittings, towers, raschig rings, special shapes. No. 438. Lapp Insulator Co.

Presses, Filter.....Filter presses de-signed and made to meet indus-trial filtration problems.....offering greater performance, flexibility and economy than ever before. Present a descriptive Catalog.

308

D. R. Sperry & Co.

Process Equipment.....Illustrates and describes its comprehensive line of standard and custom-made chemical and process equipment, and steel and alloy plate vessels, in new, detailed 8 p. Catalog.

Colonial Iron Wks. Co.

Process Equipment.....Offers important information on side-entering, portable and flange-mounted mixers, double-cone blenders, ball and pebble mills, impregnating equipment, vacuum drying equipment, etc.

417B J. P. Devine Mfg. Co.

Processing Equipment, Liquid..... New 32 p. Catalog covers entire line of stainless steel liquid processing equipment. Includes information on filters, filter discs, mixing and storage tanks, etc

4170 Alsop Engrg. Corp.

Softeners, Water.....Includes physical characteristics, sizes and capacities, operation, advantages, applications, etc., of a new continuous water softener, in completely illustrated Bulletin 4083.

Stills, Water.....Provides full détails & specifications on steam heated stills up to 250 gallons per hour; electrically heated type up to 10 gallons per hour; gas heated up to 50 gallons per hour.

Consolidated Mach. Corp.

Pumps, Blowers, Compressors

Compressors.....Releases a new, fully illustrated, 36 p. bulletin, which contains complete information on the construction and operation of heavy-duty air compressors for industry. Bulletin No. A-72.

41710 Joy Mfg. Co.

Compressors, Centrifugal.....Offers a complete line of centrifugals for gas compression and refrigeration—up to 10,000 horsepower in a single unit. Data is "Centrifugal Compressors for Industry."

Carrier Corp.

Fans.....Bifurcator fans efficiently exhaust hot, corrosive, flammable & explosive fumes. Makes available complete information in "Design Data for Exhaust Systems" & Bifurcator Bulletin DB-4-52.

371a Debothezat Fans Div.

s..... Offers helpful data concerning cooling and drying problems, system ventilation, and open surface tank ventilation. Dimensions, applications and performance data in 12 p. illustrated Bulletin 650.

Robbins & Meyers.

Fans, Exhaust.....Introduces a complete new line of corrosion-resisting exhaust fans. Offers pertinent data covering construction, dimensions, weights, and performance characteristics. Bulletin F/1.

Duriron Co. 4176

Pumps.....Detailed Bulletin completely describes and illustrates the company line of economical all-purpose pumps —water handling pumps available in the widest range of sizes and horse-power. No. B-2300.

2634 Peerless Pump Div.

Pumps.....For dependable pump service under tough operating conditions.

Available in 12 standard alloys, with heads to 240 ft. and capacities to 2000 gpm. Offers full details in Bulletin P/1.

267 Duriron Co.

Pumps....Designed and constructed to withstand abusive service—such as pumping highly abrasive mixtures, corrosive liquids, hot solutions or heavy slurries. Provides complete details in Bulletin SWO.

TR383 Nagle Pumps.

Better DUST CONTROL ENGINEERING IS IMPORTANT!

DAY engineered dust control includes plant survey, system layout, strategic location of equipment and efficient installation. These factors and many more are included in DAY'S engineered dust control to assure you the utmost in effectiveness and over-all economy.

DAY engineered dust control is backed by a program of constant research for greater equipment and system effi-ciency. For example, DAY engineers achieved an important advancement in dust filter efficiency with the dein dust filter emciency with the development of DAY'S patented SELF-ADJUSTING BLOW RINGS for the DAY "AC" (Hersey Type) Dust Filter. These blow rings compensate for any variation in filter tubes due to changes in temperature, pressure, moisture conditions, etc. They assure perfect cleaning air contact.

5 Important DAY Advantages

- 1 DAY'S continuous Reverse Jet Cleaning permits the use of more efficient filter media which gives filtering efficiencies up to 99.99+%
- 2 Constant air volumes are maintained.
- 3 Continuous, automatic operation without the necessity of shutting down any section for cleaning.
- 4 Air-to-cloth ratios to as high as 20 to 1.
- 5 Self-Adjusting Blow Rings assure perfect reverse air to cloth contact.

Write For New Bulletin

If you have a dust control problem, whether it involves a complete system or a single unit, your inquiry is invited. WRITE FOR BULLETIN 528-R.

Photo shows two of eight DAY "AC" Dust Filters used by Chas. Pfizer & Co., Inc. The filters shown are located at the Groton, Conn. plant. DAY'S Reverse Jet Cleaning permits the use of a better grade of pressed wool felt which captures even submicron dust particles.



Two of the eleven DAY "AC" Dust Filters used by Pillsbury Mills, Inc. The filters shown are in the cake mix plant at Hamilton, Ohio. Space and headroom were at a premium in this modern, one story plant and the dust control equipment was placed to consume a minimum amount of space. Leading millers and food processors recon DAY for dust control engineering.

The DAY Company

856 Third Ave. N. E., Minneapolis 13, Minn.

IN CANADA: P. O. Box 70N, Ft. William, Ontario Branch Plants: Buffalo, Fort Worth, Welland, Ontario Representatives In Principal Cities





DAY "AC" Dust Filter installation, Lapp Insulator Company, LeRoy, New York. The company reports—"most of our dust is very fine and varies in size from 1 micron to 25 microns. The DAY Dust Filter solved our dust problem", DAY "AC" Filters consistently provide filtering efficiencies up to 99.99 + %.

The single cost of TANTALUM is much less than the many costs of CORROSION.

corrosion costs do not end simply with equipment replacement. A complete analysis must include shutdowns, lost production time, product contamination and spoilage, fume damage to buildings and associated equipment, possible injury to personnel. Compare this myriad of costs against the single outlay for Tantalum, the metal that is not merely "corrosion-resisting", but acid-proof.

If you are processing hot or strong acid solutions, if you are making a pure product in which equipment contamination or side reactions cannot be tolerated, tantalum is probably the most economical material of construction you can use. Experienced Fansteel engineers are at your service for consultation at no cost to you.

Use Tantalum with economy for most acid solutions and corrosive gases or vapors except HF, alkalis, or substances containing free SO3.



Ask for a copy of our free booklet "Acid-Proof Tantalum Equipment for Chemical Operations"

FANSTEEL METALLURGICAL CORPORATION NORTH CHICAGO, ILLINOIS, U.S.A.

32402C

NEW LITERATURE

- Pumps.....To force liquids, solutions or gases through tubing ... easily, quickly. Feature no corrosion, no contamination, no valves to clog, etc. Offers complete information in il-lustrated Folder.
- Sigmamotor, Inc.
- Pumps.....Information on the number of rings, depth of box, type of packing.....chemical and physical properties of fluid being pumped, speed of shaft, and other pertinent usable facts, in Bulletin S-147.

 L369 Taber Pump Co.
- Pumps, Boiler Feed.....Used through-out industry for many services. Ca-pacities range up to 2,000 gpm, pres-sures to 1,200 psig, temperatures to 350F. Contains complete information in Catalog 1502. 313 De Laval Steam Turbine Co.
- Pumps, Bronze..... Makes available il-lustrated literature which covers the Hypro Model 4300 bronze pump, de-signed for continuous water recircu-lation use. Includes data on features and performance.

 Hypro Engrg.
- Pumps, Centrifugal.... Handle corrosive liquids. Now available in 8 different materials. Information on these new materials, performance curves, specifications, dimensions, etc., in Bulletin 725.3. Goulds Pumps
 - Goulds Pumps.
- Pumps, Centrifugal....."Centrifugal
 Pump Fundamentals" explains principles of operation, defines various
 terms used in pump calculations. &
 works out typical pump problems.
 Fully-diagrammed.
- Ingersoll-Rand Co.
- Pumps, Centrifugal.....Pumps designed for easy maintenance and service. Makes available a new illustrated Bulletin which contains design fea-tures, service features, specification data, etc. No. 1001B.

 1850 De Laval Steam Turbine Co.
- Pumps, Centrifugal.....New fractional hp pump requires no drive shaft ... no shaft seal ... eliminates 90% of difficulties encountered with conventional pumps. Characteristics, specifications, performance.

 418E Fostoria Pressed Steel Corp.
- Pumps, Centrifugal.....Type UNB 2-stage centrifugal pumps for working pressures up to 400 psi & capacities up to 1300 gpm. Offer long efficient service with low maintenance costs. Data in Bulletin W-318-S27. Worthington Corp.
- Pumps, Chemical Corrosion-resistance of chemical pumps covers entire range from strong sulphuric acid to strong caustic soda. Canacities from 10-4000 gpm—sizes ½-125 hp. Data in Bulletin 7095.
- Ingersoll-Rand Co.
- Pumps, Chemical Process.....Makes available valuable information on pumps for chemical process work—truly all-purpose pumps for higher heads and capacities. Complete description in Bulletin B-1600.

 263b Peerless Pump Div.
- Pumps, Chemical Transfer.....For continuous or intermittent light duty in transferring process chemicals. Mechanical shaft seals eliminate stuffing box troubles & shaft leakage. Provides Bulletin B-1606.
- Peerless Pump Div.
- Pumps, Controlled Volume.....Provides complete information on flow control instruments designed to provide metering accuracy at higher pres-sures... higher capacities. Details in Bulletin 1153-A. Militon Ray Co.
- Milton Roy Co.
- Pumps, High Vacuum.....Cites examples of typical vacuum systems using high vacuum pumps, and provides solutions to various problems in pump selection, in completely revised brochure. Catalog 700.

 303a F. J. Stokes Mach. Co.

→ Want more information on any of these items? Just circle its code number on the postcard inside the back cover, then mail to us. It's that easy now.

Pumps, Horizontal, Split Case......Offers detailed information on split case hor-izontal pumps. Provide numerous features—top quality...superior per-formance...highest efficiency. Bul-lets P.1300 letin B-1300.

Peerless Pump Div.

Pumps, Liquid.....Pump viscous fluids efficiently and economically... and serve as combined meter and pump due to their unusually high volumetric efficiency. Describes the entire line in Pulletts 1.51. efficiency. De Bulletin L51. 425

Kinney Mfg. Div.

Pumps, Magnetic Drive.....Present many features—liquid is confined to wetted end...leakage eliminated... revolutionary design...no packing— no seals...etc. Offers details in illus-trated Bulletin B-1607. Peerless Pump Div.

Pumps, Metering & Proportioning.....

Explains operation of the pump, illustrates its design features & gives
complete capacity & pressure information on the entire line, in new
Bulletin KP-54.

Hills-McCanna Co.

Hills-McCanna Co.

Pumps, Multi-Stage.....Company offers data on two, three, four and five-stage pumps—multi-stage split case pumps for medium capacities at high heads. Provides a full description of pump line in Bulletin B-1400. 263g Peerless Pump Div.

Pumps, Packingless Water.....Furnishes pertinent information on the company line of packingless water pumps— mechanically shaft sealed, split case, general-purpose pumps—in illustrated Bulletin B-1350.

2634 Peerless Pump Div.

Pumps, Piston-Diaphragm.....For controlled-volume pumping of fluids. Flow charts, typical applications, description & specifications of models of various capacities & constructions, in Bulletin 306.

Lapp Insulator Co.

Pumps, Processing.....Covers important data on pumps for heavy-duty proc-esging. These pumps feature rugged center-line-mount design for hydro-carbons and process liquids. Complete details in Bulletin B-1605. 263e Peerless Pump Div.

Pumps, Single Suction.....The oversize bearings handle severe strains and mean greater maintenance savings. Enclosed impellers, accessible construction, interchangeability of parts. Bulletin 976D.

Buffalo Pumps.

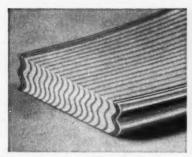
Pumps, Slurry.....Pertinent data on Hydroseal pumps—slurry, dredge, sand. Offer initial & maintained high efficiency, power savings, foolproof operation, etc. Details in illustroied Catalog 953.

Allen-Sherman-Hoff Pump.

Pumps, Slurry.....Slurry pumps handle extremely thick slurries with high specific gravities. Feature long op-erating life with little or no main-tenance. Covers features and selection data in Bulletin 181 tenance. Covers leater data, in Bulletin 181. Morris Mach. Wks.

Pumps, Sump.....Rugged, automatic sump pumps for use in basements of industrial plants or wherever large quantities of water are to be disposed of at higher heads. Offers informa-tion in Bulletin 3M-3-54.

Pumps, Vacuum.....Valuable sugges-tions on installation, starting, servic-ing, trouble-shooting, & helpful "do's" & "don'ts" on vacuum pumps & vacuum pumping systems, in fully detailed Bulletin 755. 303e F. J. Stokes Mach. Co.



Cross section view of the GUARDIAN gasket shows its unique and rugged construction—alternate layers of metal and asbestos. The inner and outer edges are reinforced with two or more thicknesses of metal, for use against acids and other chemicals, Guzenian garkst are mode of statilless steel with "Teffon" filler.



GUARDIAN gaskets are made in round, oval, square, flatside, diamond, and pear shapes. They are fur-nished in a wide range of sizes for pipe flanges, boilers and other equipment. For raised face pipe flanger, Guardian goskets with metal centering ris

Keeps joints tight automatically, regardless of

temperature changes



Guardian* Gasket

GUARDIAN gaskets assure permanently tight joints because they compress and rebound instantly and repeatedly. Thus, they conform with expansion and contraction caused by changes in temperatures. The need for retightening joints is greatly reduced resulting in less maintenance and longer gasket life.

Since Guardian gaskets do not adhere to the flanges, you save two ways: (1) time required to clean the flanges is reduced, and (2) the gaskets can frequently be reused.

Guardian gaskets are unaffected by extreme temperatures and pressures. They offer maximum protection against blow-outs and leaks under all service conditions. Get all the facts about Guardian gaskets-call your Garlock representative or write for folder AD-104.

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK

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RLOCK

PACKINGS, GASKETS, OIL SEALS, MECHANICAL SEALS, RUBBER EXPANSION JOINTS

Instruments & Controls

Analysers.....For the process plant.
For continuous control of liquid or
gas streams. Record ratio of any 2
wavelengths chosen. Thermostatted;
enclosed in explosion-proof contain-

Perkin-Elmer Corp.

Analyzers, Multi-Component.....For the pilot plant. Continuously record the concentration of up to six components in a pilot process stream on a six-minute cycle. Bulletin offers complete factals. details.

279h Perkin-Elmer Corp.

Analyzers, Gas.....Analyzers capable of indicating gas concentrations as low as 5 parts per billion . . . use most sensitive method of analysis known—detection of mercury vapor in ultra violet light.

300E Tailer & Cooper.

Comparators.....For quick, easy de-termination of pH, chlorine, phosphate or nitrate. Describes theory and ap-plication of pH and chlorine control and covers the line of comparators. Fully illustrated.

W. A. Taylor & Co. R363

Control, Filter.....System for centralized filter operation & automatic filter backwashing offers improved filter control & operating convenience, at lower plant construction cost. Bulletin 480-LJ.

Builders-Providence. Builders-Providence.

Control, pH......12 p. brochure presents picture of continuous pH recording & control in three major processing areas—water treatment, control of chemical reactions, waste disposal. Details in Bulletin 340-14.

426B Beckman Instruments.

form a standard low-voltage control system that handles all motor types up to 600 hp from central location. Offers complete information in des-criptive Bulletin GEA-3856. General Elec. Co. 103

Controllers.....Data on automatic re-cording pressure controlers for hom-ogenizers & high pressure pumps. Offer advantages of increased proc-essing efficiency, direct & immediate labor savings, etc.

4200 Manton-Gaviln Mfg. Co.

Controllers & Mcters...... 28 p. illustrated booklet covers equipment for the measurement & control of liquids & gases. Includes data on controllers, meters, gages, valves, venturi tubes,

Simplex Valve & Meter Co.

Controllers, Recording.....Offer reduced maintenance thru the "Magnetic Standard" in potentiometers and an improved bridge balancing unit in a-c bridge instruments. Data in Bulletin GED-2108 bridge inst GED-2100.

79 General Elec. Co.

trois. Temperature Furnishes data on new electronic temperature control... applicable in production processes for electric, steam & hot water heaters; baths of all kinds; ovens, kilns, dryers; etc.

E Fielden Instrument Div. 420E

Controls. Temperature.....Offers information on the company line of temperature controls. Includes purpose, operation, tube construction, switches, tube materials, specifications, etc., in Bulletin 103.

Burling Instrument Co.

Controls, Valve....LimiTorque is op-erating thousands of valves all over the world..in hot and subserc cli-mates, indoors and outdoors—speed-ily, safely, dependably. Details in Cat-alog L-54.

Phila. Gear Wks.

Gages.....For pressure, vacuum or compound service. There are no gears or teeth to wear out. Cam wiping action keeps contact points clean and smooth. Provides complete information in Catalog G-2.

Helicoid Gage Div.

Gages, Tank.....Presents valuable infor-mation on 100% automatic tank gages for gaging liquids of all kinds. Gages are approved by the Underwriters' Laboratories. Makes available detailed literature. literature. BY.382 Liquidometer Corp

Indicators, Bin Level.....Simple, reliable & inexpensive means of indicating level of granular, pulverized & semi-liquid materials stored in tanks, silos, hoppers & bins. Offers new 20 p. Book.

BL367 Bin-Dicator Co.

Indicators, Electronic Level.....For accurate, continuous level measurement of liquids or divided solids. Feature savings in initial cost and in maintenance. Complete new instrument data.

Fielden Instrument Div.

Instrumentation, Steam Generation.....

A convenient, one source reference—
32 p. illustrated bulletin—for all products of Honeywell's Industrial Division applicable to steam generation.

Bulletin 9050.

Minneapolis-Honeywell

4266

Minneapolis-Honeywell

Instruments, Industrial Honeywell's Composite Catalog offers comprehensive coverage of Industrial Division products—millivoltmeter pyrometers, Electronik potentiometers, thermometers, etc. Catalog 5001.

420H Minneapolis-Honeywell

Instruments, Mechanical.....Presents a
48 p. fully detailed & illustrated catalog which describes dial indicating
thermometers, recorders, controllers,
their accessories & diaphragm motor

walves, Weston Elecl. Instrument Corp.

Meters, Centrels, Test Equipmest.....

196 p. illustrated Catalog covers
laboratory and portable test instruments, bridges, decades and recording instruments, service instruments, etc. No. 54.

Electro-Tech Equipment Co.

Meters, Flow.....Indicating, recording, integrating & controlling instruments of both evenly graduated & square root types, as well as area meters & differential converters, covered in 60 p. Catalog 2320.

Minneapolis-Honeywell

Meters, Moisture.....Simple, portable precision instrument quickly and accurately determines the amount of surface moisture in powdered, granulated or fibrous materials. Fully illustrated and detailed.

420L Heyl & Patterson.

Potentiometers..... Dynalog Potentiometers with standard thermocouples provide unerring temperature measurement for any range up to 2800F. Offer sustained accuracy of \$\frac{1}{2}\$ of 1% of scale. Bulletin 427-1.

Foxboro Co.

Pyrometers, Pertable.....Line of sturdy precision instruments bring instant, accurate results...wherever temperature readings are required—on the production line, in the lab, or in the field.

Illinois Testing Labs M386

Pyrometers, Radiamatic....Illustrated 28 p. covers 4 types of Radiamatic radiation detectors for measuring temperatures from 125 to 7000 F. Units feature accuracy, speed, & versatility. Catalog 9301.

420M Minneapolis-Honeywell

Pyrometers, Thermo-Electric..... "Temperature Indication" features the full story on modern pyrometry and covers complete line of pyrometers especially designed for different temperature-reading problems.

420N Illinois Testing Labs.

Recorders.....New miniature electrical recorders offer extreme compactness ...Cormag self-shielding mechanism...A-C and D-C models. Offers Bulletin covering complete specifications and prices.

Weston Eleci. Instrument.

Rectifiers.....Bulletin describes different types of electroplating rectifiers, with capacities from 5 to 50,000 amperes, standard & special designs. Also covers data on regulators & controls. No. B 20-54.

Regulators, Flow.....Covers new self-contained flow regulating device for clean gas-free liquids. Requires no air or electric power. Data on fea-tures, operation, application, etc., in Catalog 10-F-70.

Fischer & Porter Co.

Regulators, Pressures.....Available for for steam, air, gas, oil, water or other fluid. Includes new internal construction features which give higher capacity & close regulation, in illustrated Bulletin C-95.

Fisher Governor Co.

Fisher Governor Co

Regulators, Temperature..... Designed to limit heater steam pressures to an adjustable maximum—need for separate reducing valve eliminated. Complete information on design features in Bulletin T50.

Spence Engre. Co.

11

Spence Engrg. Co.

Spectrographs, Production Control.....
Covers spectrograph for instantaneous
direct reading and photographic
analysis specifically developed for research and rapid production control
analysis. Scientific Specialities Corp.

Scientific Specialties Corp.

Spectrophotometer Accessories.... Increase range, sensitivity, verastility and convenience of this universally accepted instrument—the Model DU spectrophotometer. Details in Data File 40-14.

379 Beckman Instruments.

Speed Control, Turbine.....Offers new 30 p. fully illustrated bulletin, "Fundamentals of Turbine Speed Control," which clarifies operation of automatic speed control for steam turbines. No. H-21.

Elliott Co.

Telemeters, Level & Pressure.....Bulle-tin covers description & illustrations of transmitters & receivers, diagrams of installation arrangements, applica-tion & operating features. No. 230-

Builders-Providence

Testing Machines, Fatigue.....Data on fatigue machines of 13,000 lb. capacity. Elevated temperature testing, prin-ciples of "constant-force" operation & specifications covered, in descriptive Epulatin 4214. Elevatea ciples of "constant-force ciples of "constant-force specifications covered, in description Bulletin 4214.

Baldwin-Lima-Hamilton Corp.

Provide valu-

rmometers, Dial.....Provide valuable features; climate-proof case; maximum response...minimum flutter; all welded stem construction; etc. Full data on precision-built thermometers in Bulletin 144.

Manning, Maxwell & Moore.

Transducers.....Describes instruments for the measurement of gage, differential, and absolute pressures. Includes drawings, specifications, and selection tables, in 12 p. detailed Bulletin PT-1.

Statham Labs.

Transmitters, Electronic Ideally suited to requirements of modern processing plant & power station. Ruggedly built for reliable performance under severe operating conditions. Catalog 400A.

Manning, Maxwell & Moore.

Transmitters, Pneumatic Signal.....IIlustrates & describes the pneumatic
signal transmitter designed especially
for use with the Hagan ring balance
meter. Applications, operation, etc. in
Bulletin 9653M. ..II-

420 W Hagan Corp

- Transmitters, Pressure.....Can measure pressures within ½% of 20-40 psi shiftable range spans. Operate on simple force-balance principle. Includes valuable features and advantages in Bulletin 98097.

 240-1
- Weighing Systems, Electrical.....Measure batch ingredients accurately...
 automatically. Provides complete details in Data Sheet 10.18-la, "Unit Measuring Systems with Baldwin Electric Strain Gages."

 148-9a Minneapolis-Honeywell.

CONSTRUCTION MATERIALS

- Adhesives, Lagging.....20 p. Reference Manual covers data on lagging adhe-sives, sealers, surface coatings, fire retardant mastics and vapor barriers. Includes full technical products in-formation. No 545. Benjamin Foster Co.
- Asbestes.....For your most exacting in-sulation requirements. Tough—will not crack, crumble, powder. Designed for temperatures up to 1200°. Un-affected by water, vapor, tumes. Fully illustrated. Union Asbestos & Rubbar
- Union Asbestos & Rubber.
- Cements.....Describes new pour-lay cement which resists corrosive acids, acid gases, salts, solvents & high temperatures. Includes cost-cutting & labor saving advantages, technical data, prices, etc.

 221AA Sauerelsen Cements Co.
- Coatings, Protective..... Explains sys-tem of custom-made protective coat-ings. System gives positive protection to both old & new structures, & to structural materials & industrial equipment. 16 p. 421B Rowe Paint & Varnish Co.
- Coatings, Protective.....Covers properties, uses & application methods of rust-proofing, corrosion-resistant mastic coating for exteriors of tanks, vats, ducts & structural work. Fully lilustrated.
- Palladium Mastic Corp. 4210
- Coatings, Protective..... A new Bulletin on corrosion-resisting coating, lining and surfacing materials, applies new classification methods to help corrosion and material engineers. Bulletin No. 100.

Carboline Co.

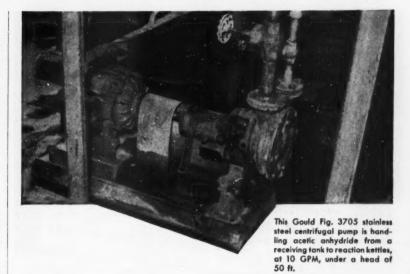
421D

- Coatings, Protective.....Primers, coatings & trim recommended in complete Tanx protection system...& data on surface preparation, priming & application of finish & trim coats. Technical Bulletin 5310.
- General Paint Corp.
- Fabrication, Industrial Equipment.....

 Modern facilities geared to meet needs
 of industrial development & expansion.
 Include manufacture of heavy machinery, medium & heavy plate-work,
 etc. 44 p.

 Treadwel! Construction Co.
- m Boards.....Describes and illus-trates Fiberglas acoustical form board for poured-in-place roof decks for industrial plants, commercial
- for industrial plants, commercial buildings and schools. Data on four basic tasks. Owens-Corning Fibergias Corp. 421G
- Paints, Protective.....Proven successful against all forms of corrosion (cor-rosive fumes, condensates and spil-age). Includes performance record with over 175 corrosives, in detailed Epileta, 750
- Bulletin 750. U. S. Stoneware Co.
- Platinum Clad.....Includes data on how it is made, thickness of platinum cladding, test for imperfections, heat exchange equipment, pyrolysis tubes, tube sizes & connections, linings for vessels, etc.

 Baker & Co.



Acetic anhydride is duck soup to this stainless steel pump

A New Jersey plant producing dyes and other textile finishing chemicals uses large quantities of acetic anhydride. This highlycorrosive material would eat the insides out of any ordinary pump in a few weeks. But this Goulds pump handles it easily and without damage.

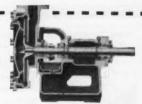
It's a Goulds Fig. 3705 stainless steel centrifugal pumpwith a design which keeps maintenance problems under control. For example, the stuffing box is under suction pressure only, so leakage is virtually eliminated. You can get at the pump's working parts for inspection and

cleaning, or for removing and replacing the impeller, without disturbing the piping connections. And you can easily adjust the clearance between the impeller vanes and casing.

For additional information about the Fig. 3705 stainless steel pump, write for Bulletin 725.3.

This is just one of a full line of Goulds pumps which includes models and sizes for almost every industrial application. If you have any pumping problem, Goulds engineers will be glad to consult with you on the type, size and installation of pump that will best satisfy your need.

Cross-section of the Goulds Fig. 3705 pump, showing stuffing box on suction side. This pu is available in stainless steel 316, FA-20, 304; all iron; all bronze; bronze fitted; all iron, stainless trim; all bronze, stainless trim. Write for Bulletin 725.3.







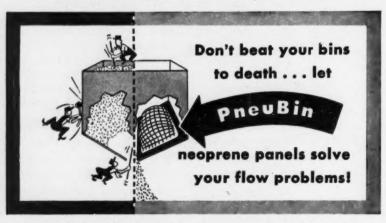
ATLANTA . BOSTON . CHICAGO . HOUSTON . NEW YORK . PHILADELPHIA PITTSBURGH . TULSA

FLOW STOPPAGE COSTS MONEY!

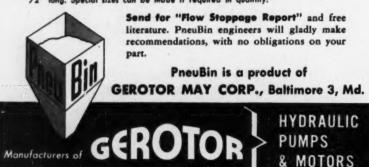
Have you ever figured how much flow stoppage costs you in: . LOST STORAGE CAPACITY? . LOST MAN-HOURS? . LOST PRODUCTION TIME?

PneuBin will solve your flow stoppage problems and help reduce your operating expense. When materials hang-up in your bins and hoppers, PneuBin starts them flowing again. The PneuBin unit consists of a steel-backed neoprene panel, mounted on the inside wall of your bin. By the pnuematic inflation and deflation of the panel, the bin contents are displaced and disturbed to activation. After the diaphragm has collapsed, the air control unit (operating off the regular plant air supply) starts another cycle of inflation and deflation. The process continues automatically at whatever frequency is set on the air controller.

Because the neoprene panel is resistant to oils and most chemicals and is also thick and tough enough to withstand severe abrasive service, PneuBin is applicable to most any bin flow problem.



Sizest PneuBin panels are available in 14 standard sizes, 4" to 24" wide, 6" to 72" long. Special sizes can be made if required in quantity.



NEW LITERATURE

Process Equipment, Fabricated Complete modern facilities including X-ray inspection and stress relieving which insure quality control. Equipment in all commercial metals and alloys. Data in Catalog 490.

34 L. O. Koven & Bro.

Selectors, Tool Steel.....Derived from a new method for the selection of tool steels designed on the fundamental basis that the application dictates the choice of tool steel. Explicit instruc-

Crucible Steel Co. of America.

effon Sheets, Cementable.....Offers per-tinent information on chemical, elec-trical & physical properties, typical uses, suggestions on application & bonding agent selection, etc., in Cata-log MI-443.

422B United States Gasket Co.

PIPE, FITTINGS, VALVES

Calculators, Vacuum.....Makes available new vacuum calculators for rapid silde-rule vacuum calculations. Includes a standard ABCD log scale. Helps determine the proper pump for

a specific process, 363b F. J. Stokes Mach. Co.

Elbows, Long Tangent.....Feature many advantages: save pipe; often eliminate short nipples & their extra welds; save time & money in lining up & clamping pipe & fitting, etc. Data in Catalog 54.

Midwest Piping Co.

Fittings.....Klinger Master Catalog de-scribes the complete range of products ...compressed asbestos sheet pack-ings for all purposes, valves, cocks, level gages, synthetic & silicone rub-

139a Klinger Corp. of America.

Fittings.....Announces availability of a new, hard cover 304 p. general cata-log (55) on seamless welding fittings, forged flanges & forged steel fittings. Illustrations, dimensions, specifications, etc. 72-3

Ladish Co.

Fittings, Corrosion-Resistant.....For use with light-wall pipe. Tangential section cuts initial costs & simplifies piping installations. Includes types, size ranges, test data, dimensions, charts, etc.

320 Horace T. Potts Co.

Horace T. Potts Co.

Fittings, Pipe.....Company furnishes information on superior corrosion-resistant pipe fittings...screwed, flanged, butt weld. Includes full description of of the complete product line, in Catalog 653.

R367 Camco Products

Hose, Metal, Flexible.....For difficult fluid and gas handling jobs. Durable and leak-proof for conveying, con-trolling movement & vibration, cor-recting misalignments, etc. Details in Bulletin 20D. Atlantic Metal, Hose Co.

Atlantic Metal Hose Co.

Nessles.....Offers information on line of airbiast cleaning noszles. Three standard models are described. Also included are pressure blast hose fittings for standard airbiast nozzles. Catalog No. 27-A.

American Wheelabrator

Nezzies, Spray.....Company provides a 48 p. industrial Catalog will full data on thousands of standard and special nozzies for every type of spraying. Also includes information on related

Spraying Systems Co.

Pipe & Fittings, Glass......Glass pipe & fittings for full-scale production operations, Strengthened by end-tempering & feature corrosion-resistance, non-contamination, etc. Catalogs EA-1 & EA-3.

Corning Glass Wks.

p, Fittings & Valves.....Corrosion-resistant saran lined pipe, fittings and valves feature greater dependability and longer life—assures tight, leak-proof joints. Makes available detailed Catalog. Dow Chem. Co.

342

Dow Chem. Co.

Piping.....Covers data on wood-lined steel, saran rubber-lined steel, wood stave and fabricated piping products ...for water, corrosive liquids, chem-ical gases, pulps, slurries, etc. Illus-trated.

Michigan Pipe Co.

Tubing.....48 p. manual offers valuable information on stainless steel and high alloy tubing. Sections include tubing classification, engineering data, tables, ordering information, advantages & selection, etc.

Trent Tube Co.

4230

Catawissa Valve & Fittings Co.

Valves.....Safe control for ammonia and other hard-to-hold fluids...with 300-lb. heavy-duty all-iron valves—globe, angle, expansion, check. Included are features, dimensions, list prices, etc. 423D Crane Co.

res......52 p. Catalog, divided into sections on magnetic, check, regulat-ing special valves, includes applica-tions, specifications, installation draw-ings, flow curves, detailed illustra-Valves. tions, etc.

423E

Marotta Valve Corp.

ves.....Gives features, application information, and specifications on valves for instrument piping and general use. New literature also includes numerous photographs and diagrams. Data Unit 234.

P Jerguson Gage & Valve Co. 423F

ves.....Presents descriptive illustrated Circular on valves available in stainless steel alloys, monel metal, nickel aluminum; in wide variety of types—globe, gate, check, needle & "Y" valves. Wm. Powell Co.

ves, Anhydreus Ammonia.....Pre-sents a new, 16 p. fully illustrated catalog describing the entire line of anhydrous ammonia valves and steel fittings for soil fertilization and in-dustrial uses. No. 802. Henry Valve Co. Valves, sents

Vaives, Ball.....Offered in sizes from 12" to 48" for shut-off service at pres-sures up to 150 psi, for water works and industrial applications. Includes valve characteristics in illustrated Bulletin 159.

S. Morgan Smith Co.

Valves, Blow-Off.....New fully illustrated Catalog introduces a redesigned blow-off line plus 1500 and 2500 lb sp Univalves. Includes installation photographs, line drawings, cutaways, etc. 12-D1.

Edward Valves

ves, Butterfly, Air-Operated Specifications of butterfly valve bodies & new Honeywell Series 800 diaphragm motor operators. Tables of allowable pressure differentials included. Bulletin 1701.

Minneapolis-Honeywell

4233

Vaives, Chlorine.....Valves designed ex-clusively for water-free chlorine gaz or liquid up to 300° F. They feature maximum safety, high corrosion re-sistance, smooth operation, etc. Illus-trated. trated.

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423 Hills-McCanna Co.



IF YOU HANDLE CORROSIVE FLUIDS THEY'LL DO THE SAME FOR YOU

The unique Saunders Patent design of Hills-McCanna Diaphragm Valves completely isolates the working parts of the valve from the flow. There is no packing to tighten or replace . . . no problem of leakage, internally or externally. You have a choice of body materials of any machinable alloy or linings of lead, glass, rubber, plastic, etc. Fifteen diaphragm materials are available including rubber, Neoprene and Teflon. There is also a wide choice of manual or remote operators. Sizes range from 3/8" through 14". May be used at pressures to 150 psi, temperatures to 350° F.

If you valve corrosive materials write today for descriptive folder. For specific recommendations send an outline of your requirements. HILLS-McCANNA CO., 2341 W. Nelson St., Chicago 18, Ill.

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V-11

- Valves, Diaphragm Metor.....Describes & illustrates double scated, single seated, low flow, Venturi, & 3-way bodies. Provides complete specifications & features of each type. 36 p.

 Catalog 800. Minneapolie Honeywell
- Minneapolis-Honeywell
- Valves, Gate......Hard rubber lined iron body gate valves for big savings in many corrosive services. Feature fully revolving double disc, parallel seat principle. Supplies complete informa-tion in detailed Bulletin. 815 Darling Valve & Mfg. Co.
- Valves, Diaphragms, Packless.....Fe ture many advantages: longer li diaphragm; positive shut-off of flor accurate flow control; minimum to bulence; easier operation; etc. De in illustrated 24 p.
- Valves, Float.....Provide more efficient liquid level & flow control. Simple in construction, rugged in service, accurate in operation, require less maintenance. Complete information in Bulletin 101-B.

 BL372

BL372

- Davis Regulator Co. Valves, Gate.....Offer compact, weight-saving structure of high-quality car-bon steel. Bolted bonnet valves avail-able in sizes ½ to 2-inch—union bon-net valves in sizes ½ to 2-inch. Folder AD-1828. AD-1881.
- Vaives, Lubricated Plug.....Available for the handling of gritty suspensions, and many other destructive, errosive, and corrosive industrial and chemical solutions. Presents full details in Bul-letin 111 solutions. letin 111.
- Walworth Co Valves, Lubricated Plug.....In full-port and venturi types, sizes up to 14", and with choice of "self-seald" two-plece plug or one-plece plug designs. Engi-neering data in 24 p. Reference Book 39-5.
- 39-5. 4246 Homestead Valve Mfg. Co.
- Valves, Lubricated Plug.....Lubricated plug valves offer new dependability with tefino gaskets, Casket advantages & characteristics: can't bind; self-lubricating; pressure tight; etc. Offers Catalog 4-CM.
 American Car & Foundry Co.
- Valves, Needle.....Leaflet describes a revolutionary type stem seal for valves used in vacuum service. Data as to service, sizes available, connec-tions, body materials, trim, and spe-cial features.
- cial features.

 Associated Valve & Engrg. Co.
- Valves, Nickel Iron..... Designed pri-marily for the chemical process indus-tries, and are recommended for low-cost control of moderately corrosive offers complete details in Bulcost cont fluids. Of letin 118. 175
- Jenkins Bros Valves, Plug.....Offer easy operation, long-life service, lasting safety. Will not stick or freeze. Perfect for hard-to-hold fluids. Simple plug adjust-ment nut eliminates sticking. Descrip-tive Catalog.

 Hamer Oil Tool Co.
- Hamer Oil Tool Co.
- ves, Porcelain.....Company makes available detailed literature covering the features and advantages of porce-lain valves. Bulletin includes com-plete description, characteristics and specifications. 237 Lapp Insulator Co.
- Valves, Solenoid..... Builetin supplies complete information concerning con-struction details, dimensions on 4 types of valves & pertinent product features. Applications in industrial fields outlined.
- A-P Controls Corp.
- Valves, Solenoid.....Illustrates and describes complete line of solenoid valves for automatic or remote control of steam, air, gas, or liquid flow. Applications, operation, etc. Bulletin

- Valves, Thermostatic Expansion.....In-cludes data on line of valves, filters & driers for air conditioning & refrig-eration industry. Product specifica-tions, charts, how-to-select informa-tion, etc.

 A.P. Controls Corp.
- A-P Controls Corp.
- Valves, Welded Bonnet.....Describes a thirty minute service operation for welded bonnet, integral seat valves that does not require removal of valves from the line. Details in Bultietin 531.
- Edward Valves

ELECTRICAL EQUIPMENT

- tactors, Air-Break.....Durability & long-term dependability were given prime consideration in the design. As result, the roughest repetitive duty becomes routine. Data in Bulletins 14B6410B, 14B7302. Allis-Chalmers Mfg. Co.
- Drives, Electric Power.....In nation-wide user survey of electric power drives...86% increased production, 48% improved product quality, 64% reduced production costs, etc. Data in Catalog G-413. 99 Sterling Elec. Motors.
- Electrical Equipment.....Makes available a completely illustrated 16 p. booklet explaining why electrical equipment for hazardous locations is designed and built as it is. Details in Bulletin 2660.
- Crouse-Hinds Co
- Hiuminators, Gage.....Describes, illustrates, & gives specification information on gage illuminators. Give even diffusion of light over entire gage length. Complete details in New Data Unit 242.

 Jerguson Gage & Valve Co.
- or Controls.....Company provides broad line of motor controls for the chemical and process industries—in special enclosures for all operating conditions. Contains full information in new 120 p. Catalog. Allen-Bradley Co.
- Motor Units.....Simple and rugged motor units for valves, floorstands & sluice gates. Have fewer components...providing greater dependability, much lower maintenance. Details in new Catalog 51.

 Chapman Valve Mfg. Co.
- .. Enclosed motors meet tough ors....Enclosed motors meet tough requirements for chemical industry. Makes use of industry's latest ma-terials including silicone, polyester film, Textolite & neoprene. Presents detailed Bulletins.
- General Elec. Co.
- Moters.....Offer continuous trouble-free performance. Wide range of types and sizes in complete line permits selection of a standard motor for almost any need. Full details in Bul-letin MU-185.
- Wagner Elec. Corp.
- Moters, Control..... Offers catalog covering the complete line of Honeywell Industrial control motors & industrial motorized valves. Specifications, ordering data, price supplement, etc. Catalog 8203.
- Minneapolis-Honeywell
- Motors, Gear..... Features include precision processed, file-hard gears, large oil reservoir for abundant splash lubrication, heavy, rigid cast iron pyramidal base, etc. Offered from 1 to 150 horsepower.
- Motors, Gear.....Advantages of the gear unit and motor discussed. Gear ratios for single, double and triple reduction types given. Includes a description of the full company line. 15 p. Booklet B-5645. Westinghouse Elec.
- Westinghouse Elec. Corp.

- Switches, Limit, Liquid Level.....Accurately control liquid levels...eliminate switch failures. Covers valuable data on uses, exclusive features, specifications, etc., in illustrated Bulletin 1100 letin 1100.
- Revere Corp. of America
- Transformers, Variable Provide many valuable features: higher ratings; smaller size; simplified mounting; accessible brush assembly; new type terminal connections; etc. Data in illustrated Bulletin P354.
- Superior Elec. Co.

MECHANICAL EQUIPMENT

- Belts, V-.....Makes available bulletin which provides in condensed form the necessary information on the new method of calculating the hp capacity of a "Texrope" V-belt drive. Bulletin 20B6956B.
- Allis-Chalmers Mfg. Co.
- Belts, V-.....Supplies valuable data on new Veelos TD & TE adjustable V-belts for D & E drives. Easier to couple & uncouple & longer lasting. Complete story in new 8 p. illustrated Catalog.
- Manheim Mfg. & Belting Co.
- Casters & Wheels.....Provide maximum floor protection, economy and efficiency. Sturdy construction offers extra long life of satisfactory service. Types and sizes for every purpose. Details in Manual.

 B376

 Darnell Corp.
- Darnell Corp.
- Drives, Chain, Silent.....88 p. offers de-tailed engineering data. Covers de-sign & application information, drive components & accessories, operational & technical data, etc. Illustrated Data Book 2425.
- Drives, Poly-V..... New concept of power transmission. Features include solution to matching problems, reduced belt & sheave inventory with greater interchangeability, longer life for belts & sheaves.

 4240 Raybestos-Manhattan.
- Drives, Shaft Mounted.....These versa-tile, new speed-reducing units save space, power, material and time. Makes available an engineering Bul-letin which includes selection and dimension details.
- Fasteners, Stainless Steel.....Stainless fasteners & pipe fittings in stock. All types & sizes of screws (hex head, Phillips, slotted, socket), bolts, nuts, rivets, etc. Offers complete data in Manual P6.

 BR369 Allmetal Screw Products Co.
- Gaskets.....Assure permanently tight joints—are unaffected by extreme tem-peratures and pressures. They offer maximum protection against blow-outs & leaks under all service condi-tions. Folder AD-104. 419 Garlock Packing Co.
- Packings.....Provide better sealing, longer runs, & less friction on rods, shafts, sleeves. Precision-made diemolded rings & ring sets available for requirements. Contains full data in File DMCE.
- TL376 Durametallic Corp.
- Packings, Teffen.....Company makes available a new Catalog on "Chemi-seal" general-purpose packings, made of chemical-resistant teffon. Conven-ient, how-to-order data included. Bul-letin TP-454. United States Gasket Co.
- Rings, 0-.....Company makes available a 12 p. illustrated Brochure giving detailed information on compounds, groove dimensions and sizes. Booklet also contains various diagrams of typical applications. 424Q Goshen Rubber Co.

Rings, O-.... Announces marketing of new molded Palmetto O-ring packing for static & dynamic applications. Effects important savings for de-signers & builders of equipment. De-tailed literature. Greene, Tweed & Co.

Greene, Tweed & Co.

Rings, Raschig.....Split metal raschig rings offer valuable features: un-breakable; high surface area; low pressure drop; light weight; easily cleaned. Increase operating capacity of packed towers.

Johns-Manville.

s, Mechanical.....Ability of company line of mechanical seals to handle corrosive liquids proven by the thousands of successful installations. Provides complete data in Bulletin W-350-B16.

Worthington Corp.

Turbines, Mechanical Drive.....Illustrated 16 p. gives emphasis to design features & proper control of mechanical drive turbines. Modifications, specifications, dimensions, etc. Bulletin H-22.

Turbines, Solid Wheel......Feature reliable, trouble-free operation. Rugged construction & superior design result in savings by keeping maintenance costs to a minimum. Details in Bulletin S-116.

Terry Steam Turbine Co.

nches.....For jobs requiring size & power & sweeping leverage. Feature speed—big handles, adaptors & sockets sleekly proportioned, versatile, fast working. Covers 4000 hand & bench tools. 104 p. Span-On Tools Corp. Wrenches.

Snap-On Tools Corp.

HEATING & COOLING

Boller Packages.....Includes correctly sized automatic gas-fired boller complete with gas burner and controls to maintain required steam pressure and an automatic boller feed system. Offers Bulletin 2K.

B382 Mears Kane Ofeldt.

Burners.....Offers important data on low pressure air type burners for either oil or combination oil & gas. Includes description of features, ca-pacities, dimensions, etc., illustrated Catalog 413. Hanck Mg. Co.

425D Hauck Mfg. Co.

Burners.....Thousands of burners, in chemical industries, have speeded up and improved many heating processes. 30 types and 800 sizes fully described and rated in detailed Catalog. Lit-erature H54-16. L429 Surface Combustion Corp.

Burners.....From 7000 to 15,000,000 b.t.u. per hour, with 59 burner styles in 333 sizes. Feature advantages of better combustion. more production and lower cost. Data in illustrated Folder.

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112 & 122.

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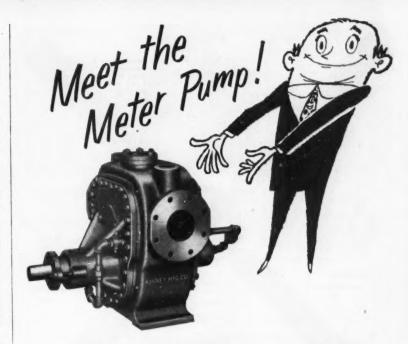
354 Niagara Blower Co.

Coolers, Cascade Corrosion-resist-ance prevents chemical attack inside tubes and permits the use of river or sea water as coolant. Includes heat transfer nomographs, tables, etc. in Catalog PE-8

Catalog PE-8. 14-5b Corning Glass Wks.

Dryer-Coolers..... Effective, economical dryer, cooler or dryer-cooler capable of processing large quantities of ma-terial with a uniform result. Complete information in 20 p. Illustrated Book

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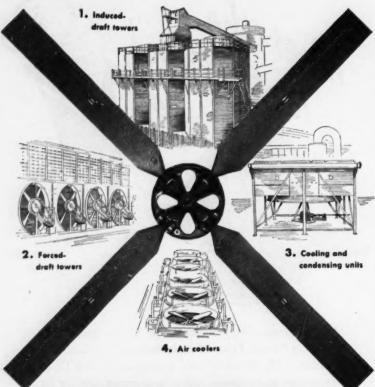


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Kinney	Please send Bulletin L51 describing the complete line of Kinney Liquid Pumps.
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Why? Because he knows from experience that Aeromaster Fans can be relied upon to give good

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De Laval Separator Co.

Heat Exchangers.... Descriptive Catalog provides information on shell and tube heat exchangers... for every type of service. Also includes pertinent data on company line of centrifugal pumps.

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Heat Exchangers Experience in designing custom-built heat exchangers for all sorts of chemical and petroleum applications, balos to exclusive the contraction. applications...helps to solve specific problems. Bulletin covers heat exchanger design.

Downingtown Iron Wks.

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Thermal Research & Engrg. 346

Heat Transfer Equipment Provides heat transfer equipment for the most exacting services in petroleum refineries, chemical plants & related industries. Describes wide range of equipment.

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Heat Transfer Media.....Eliminates the need for jacketed equipment. Uses, features & description of a new con-ception for providing uniform tem-peratures in process piping & equip-ment. Fully detailed.

426A Thermon Mfg. Co.

Heaters, Air, Direct Fired.....Readily adaptable to wide variety of uses in ovens, kilns, dryers, etc. Includes information on applications, operation and typical sizes, in illustrated Bulletin 104.

296C Thermal Research & Engrg.

Heaters, Electric.....Feature depend-able, efficient, economical around-the-clock service in applications requiring continuous, accurately controlled tem-peratures. Offers complete details in Catalog. 50 peratures. Catalog 50.

Edwin L. Wiegand Co.

Heaters, Gas-Fired.....Fully automatic gas-fired Speedheaters eliminate need for central heating plants...run on low-cost natural, manufactured or LP gas. Pertinent information in Catalog gas. 1525.

Westinghouse Elec. Corp.

Heaters, Steam & Hot Water.....Feature outstanding advantages: instant, low-cost heat; easy installation; any ap-plication; dependability; design effi-ciency; quiet operation; etc. Catalog

Westinghouse Elec. Corp. 275-5b

Piatecolis.....For tank heating and cooling problems due to inefficient pipe colis. These cost-saving Plate-colis heat or cool 50% faster and take 50% less space in the tank. Bulletin P61.

Tranter Mfg.

Platecolis..... Features a twelve company report on use of Platecolis in a variety of process heating and cooling applications. Covers data with regard to cost-saving advantages.

Brochure 154.

426B Tranter Mfg

Tubes, Condenser.....Includes informa-tion on copper alloys, condenser tube corrosion, photomicrographs of grain structure of different metals under varying operating conditions, etc.

Revere Copper & Brass. 233a

- Tubes, Heat Exchanger.....Analyses and mechanical properties of twenty-nine carbon, alloy and stainless tubing steels used in various types of heat exchangers and condensers. Bulletin TB-329A.

 427A Babcock & Wilcox Co.
- Tubes, Heat Exchanger, Aluminum.....
 Offer advantages of low cost & resistance to corrosion. Describes types, their physical, mechanical & chemical properties, typical applications, etc. Illustrated.

 427B Aluminum Co. of America
- Aluminum Co. of America
- Vaporizers, Vertical & Horizontal

 For liquified petroleum gases—propane & butane . . for chemical liquids—ammonia, chlorine, SO₂. Dimensions, specifications, design features of the second second

tures, etc. Richard M. Armstrong Co.

HANDLING & PACKAGING

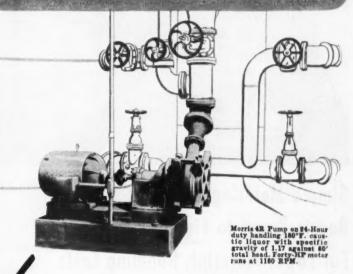
- Containers, Steel Shipping.....Collaps-a-tainers offer drastic reductions in handling costs. Numerous advan-tages—lightweight, rigid & strong, easy to assemble, stack safely, dur-able, etc. Illustrated. 427D Republic Steel Corp.
- Conveyors.....Handle packages, parts, units—faster—at reduced cost with gravity or power roller, belt, slat, chain, wheel or push-bar conveyors. Offers complete description in Bulletin 63-D.
- Standard Conveyor Co. 347
- Conveyors.....Furnishes valuable data on the cost-cutting advantages of a new type multiplane bucket trolley conveyor with a patented "Stif-Arm" bucket hanger design. Details in illus-trated Bulletin MT-254. 427E Hapman Conveyors. Hapman Conveyors.
- Conveyors, Screw.....Feature efficient operation plus long-life, low-main-tenance service. Makes available a 92 p. screw conveyor book of pre-engineered selection and application data. Book No. 2289.
- Link-Belt Co.
- Doors, Factory New rubber-covered, heavy-duty factory doors designed to withstand the pounding, bumping wear of industrial lift trucks passing through . . illustrated & described in Bulletin 52. 427F American Hard Rubber Co.
- Drums.....Steel drums assure complete product protection. They are scale-free and rust-inhibited. Furnished in capacities from 2½ to 110 gallons. Presents full information in illustrated Brochure.

 55 U. S. Steel Products Div.
- Elevators, Manlift.....For use in all multi-floor buildings where there is vertical processing of products &/or where frequent, quick inspection of machinery on various floor levels is required. 8 p.

 427G Humphrey Elevator Co.
- Feeders.....For micrometer accuracy in fluid feeding . . . at constant rate of flow proportionally. Applications include catalyst testing, additive injection, etc. Offers data in Bulletin SM-3005-2.
- Proportioneers, Inc.
- Feeders, Belt Gravimetric Push button control from central control panel for continuous compounding of dry materials. Feeders are totally enclosed, dust-tight, etc. Bulletins 35-G5 & 35-F5B. Omega Mach. Co.
- Formalin Handling.....Formalin Han-dling Manual covers unloading, stor-ing, temperature effects, safety pre-cautions, tankcar construction, methods of analysis, first ald, specifi-cations, properties.
- cations, properties.

 Celanese Corp. of America.

For Continuous 24-Hour Pumping of solid or-chemical mixtures



Morris Type R Slurry Pumps

Ordinary harsh abrasives wear out your pump. Corrosive action of acids eats away its utility. Time-consuming maintenance and repairs cut down your production. Here's why the Morris Type R helps avoid these problems . . .

- 1.—Simple design. No internal studs and bolts—no troublesome internal joints and fits.
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- 4.—Large hydraulic passages. Permit low velocities to minimize wear and frequency of renewals.
- 5.—Drive-side suction. Stuffing box troubles practically eliminated under conditions of high suction pressure, high vaccum and high suction lift.

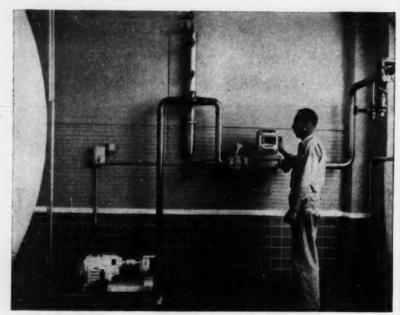
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Simple Metering System **Boosts Trend to Liquids** For Lower Materials Handling Costs

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Liquid sugar, for example. It's delivered by tank truck to a simple storage and pumping system in your plant. Put a Neptune Auto-Stop meter at each mixer or kettle and you literally have "push-button control." You just push buttons on the meter to set the quantity, open the valve, and the Auto-Stop shuts off automatically . . . "on the

You make these savings: (1) Fewer rejected batches; (2) no heavy bags to lug, no scale weighing; (3) no sifting or

spills, hence fewer rodent problems; (4) save valuable storage space by placing tanks in cellars or on roofs; (5) cut hidden losses, get easier inventory figures.

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NEW LITERATURE

Jacks.....Explains how to choose right jack for the job, lists types of ratchets, screw & hydraulic jacks—from 3 to 100 ton capacities—with full specifications for each jack. 40 p. Catalog 204.

Duff-Norton Mfg. Ca.

Duff-Norton Mfg. Co.

Magnets.....Describes the line of elec-tric & non-electric magnets for instal-lation in, on or above material con-veying systems & integration with processing machinery. Full details in Catalog C-5000-B.

262

Dings Magnetic Separator.

Pulleys, Magnetic.....For tramp from removal. Design & position of magnets provide a uniform, powerful pulling force. Operate anywhere with no current required. Offers details in Bulletin 350C-1.

Stearns Magnetic.

Ramps, Dock.....Makes available a new, completely illustrated Bulletin offering information on its Adjust-A-Dock Model No. 20 N. F. 20,000-lb.-capacity non-floating hydraulic adjustable ramp.

Rowe Methods

Ramps, Magnesium.....Provides de-tailed literature which describes & illustrates new improved, modernized design features of magnesium ramps for car loading, truck loading & yard loading operations. 428C Penco Engrg. Co.

Separators, Magnetic Combines auto-matic alarm system with permanent magnetic separator. Protect against machinery damage, fires, product contamination by tramp iron. Details in Magnalarm Bulletin.

Eriez Mfg. Co.

Sweepers, Magnetie.....Bulletin offers data on permanent magnetic Super Sweepers. Remove dangerous tramp iron from floors, parking lots, ware-houses, etc. Four sizes in three mag-netic strengths. netic strengths

Tanks.....Feature superior quality...
for longer service life, for lower
maintenance, for vital extra safety.
Tanks are thoroughly x-ray inspected
and stress relieved. Furnishes descriptive literature.
Z69 American Car & Foundry Co.

ps, Magnetic.....Permanent non-electric magnetic traps designed for economical, efficient protection against passage of tramp iron thru pipelines carrying liquids & semi-solids. De-tailed Bulletin. Traps, Ma

Trucks, Floor.....Company presents a new, fully illustrated Bulletin featur-ing Tow-Line Systems for cost-saving, "production line" materials handling in warehouses & freight terminals. No. 54-TL.

Nutting Truck & Caster Co.

Trucks, Fork..... New 16 p., completely illustrated Brochure presents a thorough description of electric work truck line. Includes pertinent information on operation & construction features.

Clark Equipment Co.

Vibrators.....Installation of the com-pany line of vibrators for smoother, more efficient materials handling... for granular or powdered chemical materials. Makes available descrip-

PROCESSES, SERVICES, MISC.

Alarms, High/Low Flow.....Meet need for high accuracy-high sensitivity alarm device for rotameters, mano-meters and similar process instru-ments. Full information in illustrated ments. Full Bulletin 165.

428F Brooks Rotameter Co. Design & Construction Fabrication of vessels, agitators or precision machinery . . . to engineering, design and contruction of process units or entire industrial chemical plants. Provides full details.

Industrial Process Engrs.

Filter Aids.....Dicalite offers a wide range of uniform materials which af-ford high throughput with filtration "sharp" enough to remove solids in size range of bacteria. Data in Tech-nical Bulletin.

Dicalite Div.

dionation Research.....Pertinent data on a cooperative non-profit organization established for the purpose of developing the ultimate in fractionating equipment, in 16 p. illustrated Booklet.

Fractionation Research. Fractionation

Graphitization.....Illustrated booklet discusses graphitization from the standpoint of temperature, chemical composition, deoxidation practice, preweiding microstructure, welding conditions, etc.

Laboratory Equipment.....Covers data on combination science desks, center tables, instructors' desks, & home-making units designed for the mod-ern school laboratory. Complete de-tails in Catalog EC-2.

429C Metallab Equipment Corp.

Laberatory Equipment.....Offers a 12 p. Bulletin featuring a new sink unit made entirely of chemical resistant polyethylene. Contains descriptions & illustrations of many new laboratory

items. Arthur S. La Pine & Co.

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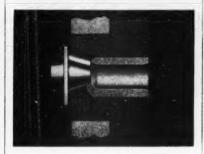
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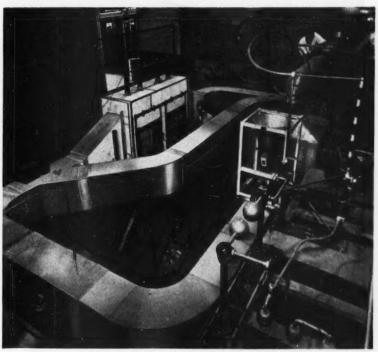
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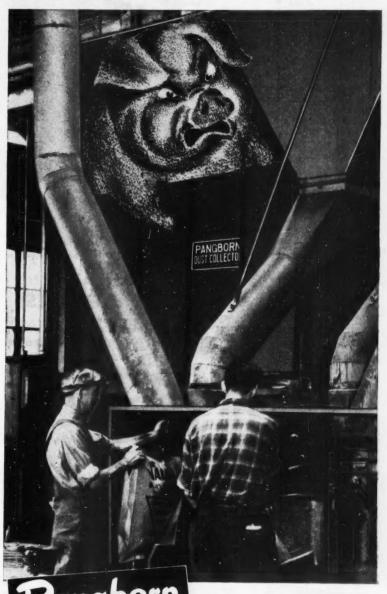


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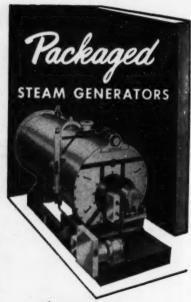
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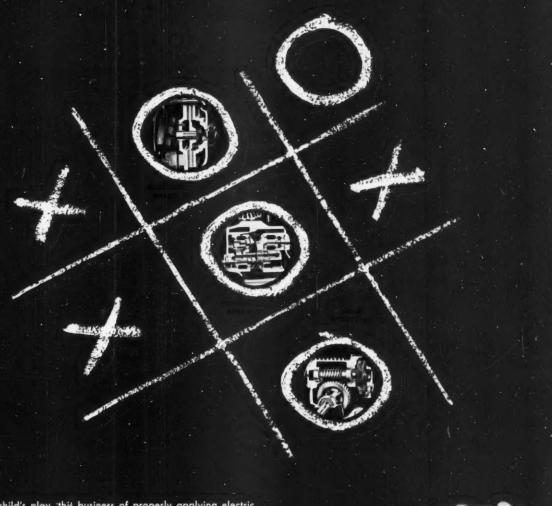
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If you have a problem of product contamination, you may get an easy answer by checking the corner card below and mailing it to Pfaudler.

The Bonnet that Heads Off Corrosion!

Corrosion-proof Hastelloy and glassed steel join forces to resist severe acid attack

Handling pure monochloro acetic acid free of low-boiling acid chlorides requires a heat exchanger that shrugs off relentless corrosive action. To meet this need, New York-Ohio Chemical Co., a subsidiary of Stauffer Chemical Co., turned to Pfaudler corrosioneering. The answer: Hastelloy "C" for the tubes, and glassed steel for the bonnets, or headers. This combination cuts down according by well as corresion. By

The answer: Hastelloy "C" for the tubes, and glassed steel for the bonnets, or headers. This combination cuts down on expense as well as corrosion. By using costly Hastelloy only where absolutely necessary, and taking advantage of the less expensive corrosion resistance of glass plus the working strength

of steel, substantial savings were made. To solve problems such as this, Pfaudler corrosioneers enjoy complete freedom in selecting materials. With every type of alloy, from stainless steel to titanium, at their disposal they can give you exactly what your process requires. And, when practical, they can also call upon famous Pfaudler high-acid resisting glassed steel.

For an unbiased recommendation on your corrosion equipment problem, talk it over with your Pfaudler representative. Or check the corner card for further information.

Please send r	more information on:
Immediate equipment	e delivery of glassed stee
☐ Corrosion	materials forprocess
Clopwood a	tool for many
Grassed s	teel for processing
Grassed s	teel for processing
NAME	teel for processing
-	teel for processing.
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